DAMOS

DISPOSAL AREA MONITORING SYSTEM

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III. Field Verification Program (FVP)

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VOLUME II

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III. FIELD VERIFICATION PROGRAM (FVP)

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III. FIELD VERIFICATION PROGRAM (FVP)

1.0 INTRODUCTION

Through the Disposal Area Monitoring System program (DAMOS), the New England Division of the Corps of Engineers has been supporting a joint EPA-COE project at the CLIS disposal site since March 1982. A description of the Field Verification Program (FVP), the baseline surveys and subsequent disposal site selection have been presented in DAMOS Contribution #23. To briefly summarize the conclusions of that report, the proposed FVP site (Fig. I-1-2) at the northeast corner of the CLIS open water disposal area (41°9.39'N, 72°51.75'W) was characterized by a flat, gently sloping topography with the typical Central Long Island Sound mud bottom. The disposal site was considered to be very homogenous and typical of natural sediments in the region. These conclusions were reached based on sediment chemistry, diver observations and the REMOTS interface camera. Suspended sediment measurements indicated that the potential impact on the FVP site of other proposed disposal operations in the southwest corner of the CLIS disposal area would be negligible.

This report describes continuing DAMOS operations in three phases: the remaining pre-disposal surveys, the disposal operation itself, and the immediate post-disposal surveys that were conducted through September 1983. The data include bathymetry and side scan sonar measurements, diver observations, suspended sediment measurements, REMOTS profiling, sediment chemistry, density probe measurements and visual observations of cores.

2.0 METHODS

2.1 Bathymetry

Bathymetric surveys were conducted at the FVP site (Fig. III-2-1) during the pre-disposal phase on 10 December 1982, during the disposal operation on 26 April and 5 May, and immediately following disposal on 19 May, 20 June, 29 July and 23 August. A survey grid was established consisting of 33 transects, 800 meters long oriented in an east-west direction and spaced 25 meters apart. When conducting the surveys, navigation control was provided by the SAIC Navigation and Data Acquisition System.

2.2 REMOTS

Although the replicate bathymetric surveys provide a reasonable approach to remote sensing of disposal mound stability over time, they are somewhat restricted in their ability to detect small vertical changes in depth (±20 cm) on a point by point basis. Therefore, while they can define the extent of the disposal mound and the total volume of material present, the bathymetric survey should not be used to delineate the extent of the spread of material. The classic description of dredged material dispersion following disposal from a scow includes convective descent. This creates a mound at the disposal point, surrounded by an apron of finer material with decreasing thickness at greater distances from the point of impact. As this apron becomes finer, detection by acoustic measurement becomes impossible and other methods must be used.

For this study, three techniques were used to evaluate the distribution of material; diver observations, the REMOTS interface camera, and side scan sonar. Diver observations provide a unique capability to combine subjective observations and discrete measurements in order to obtain an understanding of sediment distribution and behavior. They have the limitation of restricted coverage and poor navigation control. The REMOTS camera (Fig. III-2-2) (Germano, 1983) provides vertical photographic images of the sediment/water interface to a nominal depth of 18 cm and can be used to map specific parameters such as dredged material thickness, surface boundary roughness, oxidation depth, modal grain size and other more general information related to benthic biology, including faunal succession and bioturbation effects. The primary advantage of the REMOTS camera is its ability to accurately measure small thicknesses of dredged material over the fringe areas efficiently with excellent navigation control and replication of measurements. The side scan sonar provides a capability for assessing the overall physical characteristics of the disposal sites, and can detect and display relative differences in surface sediment density. The side scan sonar is particularly effective in displaying the areal distribution of dredged material within the disposal site.

2.3 Nuclear Density Probe

A major effort of this program has been an assessment of the accuracy, reliability and practical application of a Model 3565 Nuclear Density Probe, manufactured by Troxler Electronic Laboratories Inc. Since sediment density is known to be closely related to other geotechnical properties of sediments, use of the probe could provide valuable insight into changes in sediment properties caused by dredging and disposal operations. In order to accomplish this work, SAI personnel were required to attend a course in the handling of radioactive material and, as a result, obtained licenses for operation of the system. When this was completed, the unit was delivered and initial measurements were conducted in April 1983.

The Nuclear Density Probe works on the principle of measuring backscattered gamma radiation emitted from a Cesium 137 radioactive source that is mounted at the base of a stainless steel rod. When this rod penetrates the sediment, the intensity of backscattered radiation is a function of the density of the material. Since the radioactive source is continually decaying, the instrument must be calibrated each time it is used by measuring the backscatter intensity in a liquid of known density.

In practice, this calibration is accomplished by taking a series of standard counts in a container of water and measuring

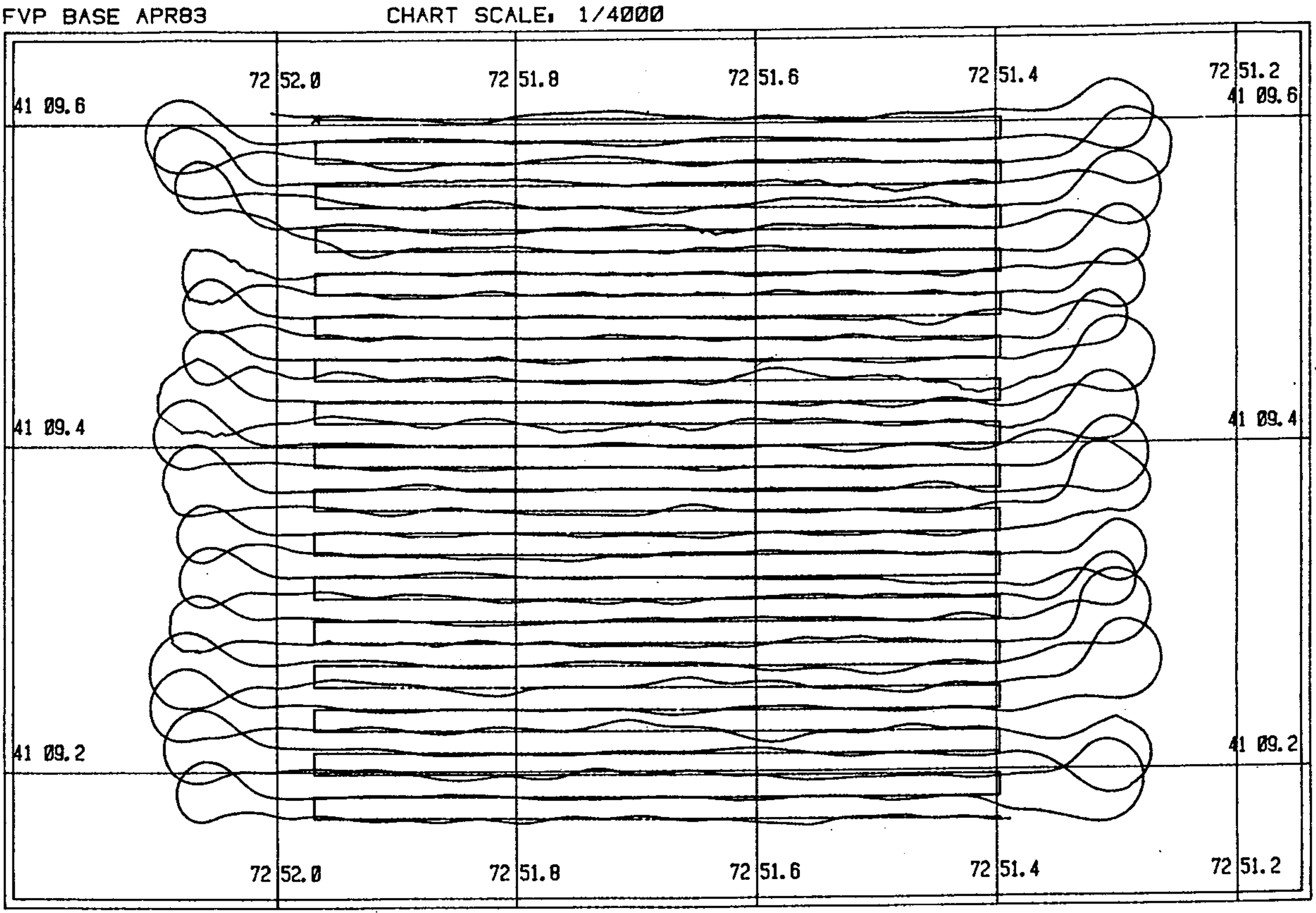
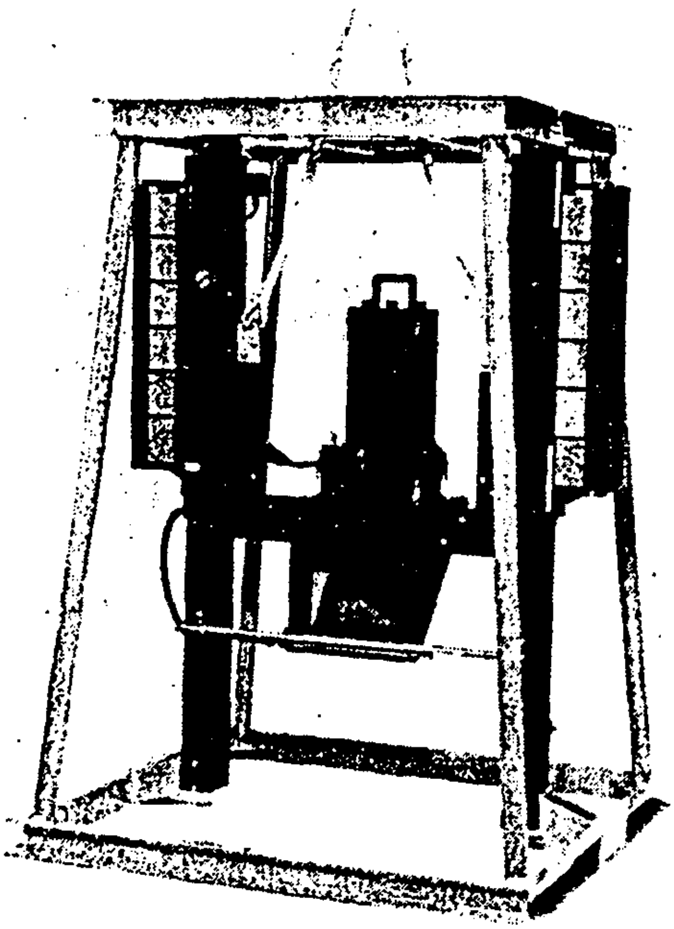


FIGURE III-2-1. Ship's Track, FVP Base, April 1983.



REMOTS CAMERA

FIGURE III-2-2

the density of the water with a laboratory grade hydrometer. The density measured by the hydrometer is then input to the microprocessor via the instrument control module and then used to calibrate observed counts for determination of actual density measurements.

Measurement stability and drift are two major factors that must be evaluated to insure that the probe will remain in calibration. The stability of the probe is determined by taking the ratio of the standard sample period of the backscatter counts to the mean number of counts per sampling period. If this ratio is less than .35, the instrument is considered stable. The drift of the unit is measured in a similar manner by obtaining two groups of standard count measurements separated in time. The ratio of the difference between these two measurements and their mean is expressed as a percentage of the drift rate. If the drift rate is less than 1%, the drift is normal and can be accounted for when calculating density over a significant time period. Examples of stability and drift tests, made during a typical sampling operation, are presented in Table III-2-1 and they indicate that the probe used on this project was well within specifications.

After replicated calibration counts have been obtained, the probe is used to make a series of density measurements according to the procedures described in Figure III-2-3. At each sample location, the probe is inserted into the sediment, at .5m increments, and three fifteen second counts are made at each depth increment to determine density. At the completion of sampling, a second calibration is made using the hydrometer procedure and instrument drift is calculated for application to the density measurements.

Analysis of the data consists of simple statistical procedures that determine the mean and standard deviation for all replicate counts within a given depth increment. This mean value is then considered a data point for application to studies of density and other geotechnical parameters.

An important aspect of the program to examine sediment density as it relates to capping operations was the requirement to obtain data at the disposal sites in up to 20 meters of water. Diver operation of the probe was not feasible, due to the requirement for a large number of sample locations and the necessity for accurate placement of the probe. In order to obtain these measurements from shipboard, a frame was designed for multiple station sampling while at the same time controlling the depth of penetration so that vertical profiles of density could be obtained.

The frame, shown in Figure III-2-4, consisted of a broad wooden base with a four sided framework of angle iron, 2 meters high, which supported a pipe that was slotted on both sides to hold the nuclear density probe. The probe and its associated stainless steel rod and cable were inserted into the pipe and attached to a collar with tongs extending beyond the

TABLE III-2-1. Stability and drift test for Nuclear Density Probe.

STATISTICAL STABILITY TEST

TEST NUMBER	DENSITY STANDARD COUNTS	
1	3518	(NORM)
2	3519	"
3	3523	"
4	3507	"
5	3503	"
6	3512	"
	$\bar{X}$ = 3513.67	

$\bar{X} = 59.28$ $\sigma = 7.69$

$\text{Ratio} = \frac{7.69}{59.28} = 0.13$ → Instrument is stable

INSTRUMENT DRIFT TEST

TEST NUMBER	DENSITY STANDARD COUNTS
1	3515
2	3500
3	3495
4	3494
5	3518

$\bar{X} = 3504.40$ $\sigma = 11.33$

Total Average = (3513.67 + 3504.40)/2 = 3509.04

Difference = 3513.67 - 3504.40 = 9.27

$$\text{Drift} = \frac{9.27}{3509.04} \times 100 = 0.26\%$$

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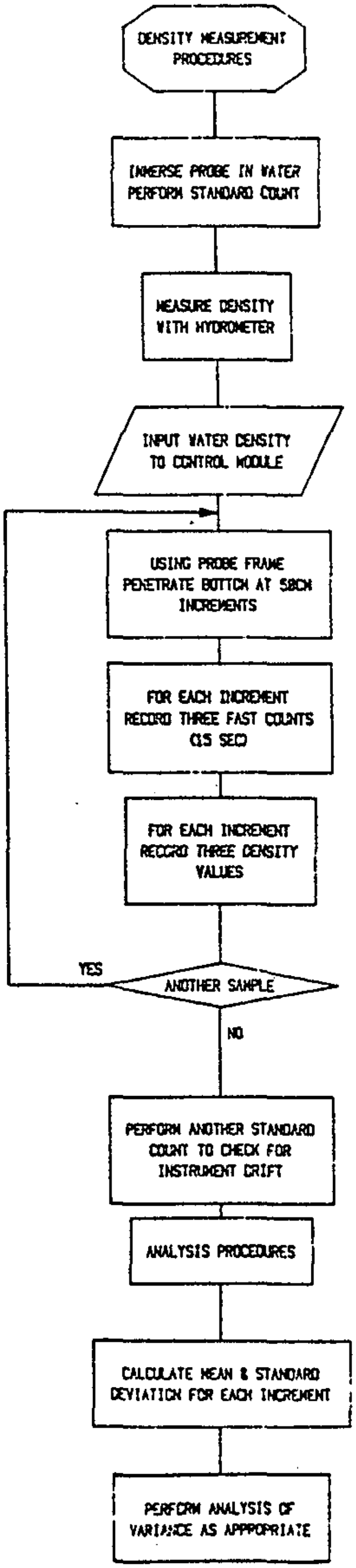

SEDIMENT DENSITY MEASUREMENT PROCEDURE

FIGURE III-2-3

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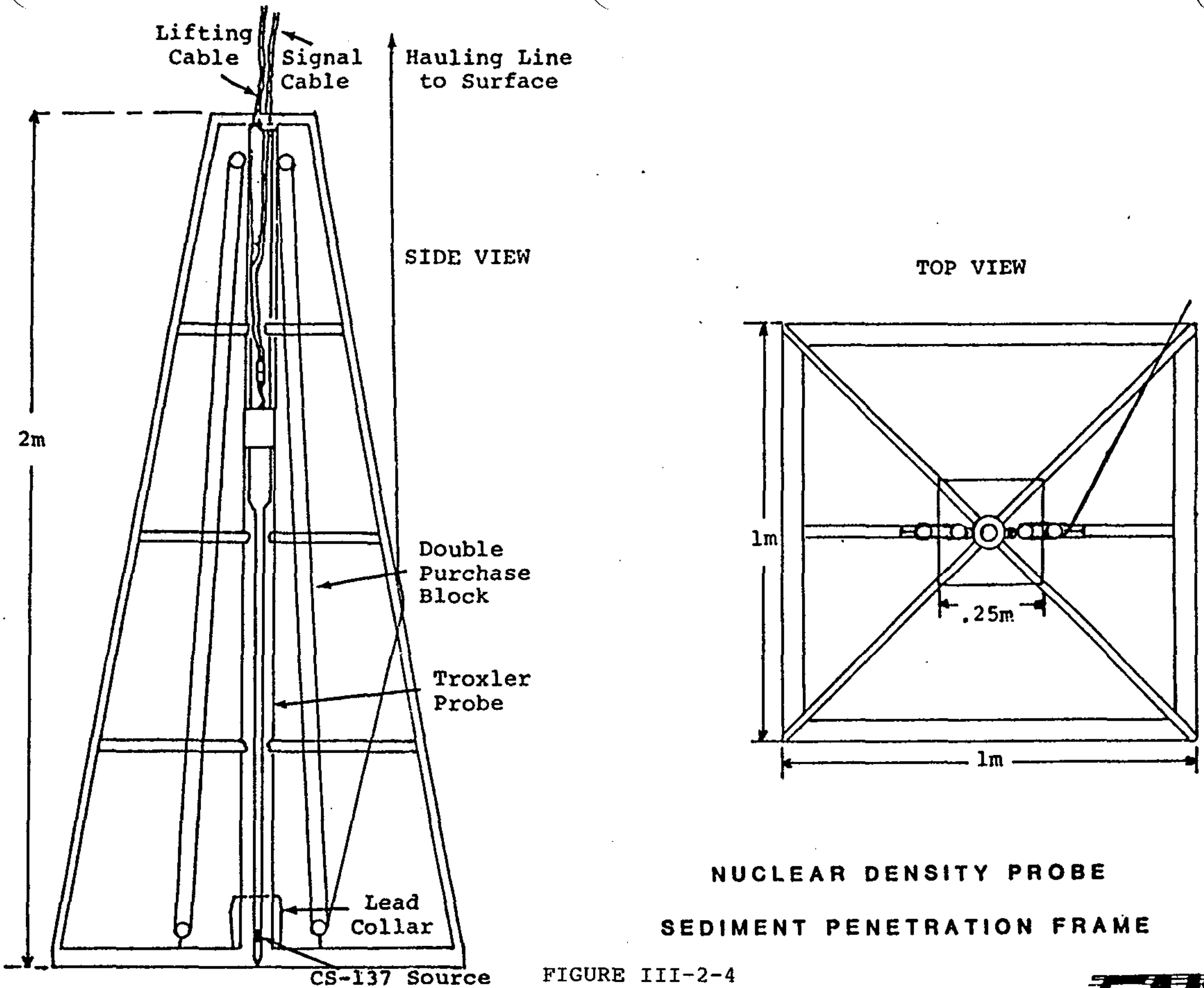

NUCLEAR DENSITY PROBE

SEDIMENT PENETRATION FRAME

FIGURE III-2-4

surface of the pipe for attachment of a block and tackle rig. Surrounding the base of the pipe was a lead collar that shielded the radioactive source when the probe was on deck. A double purchase block and tackle rig was installed within the frame using Kevlar line to reduce stretch. This Kevlar line was led to the surface and, when the frame was lowered to the bottom, provided the necessary force to penetrate the probe into the bottom. Since a 4:1 purchase was used, each 0.5m of penetration equalled 2m of line at the surface. In order to determine the total amount of penetration that occurred, a marker was inserted in the slot of the tube which would indicate the maximum depth of penetration at each station.

Two extremely different sediment types had to be considered when designing this probe; the soft mud of Black Rock Harbor and the hard sand of the New Haven outer channel. Consequently, the base of the support frame was provided with two removable wooden flaps, which provided a large surface area to prevent sinking into the soft mud. Conversely, these flaps were removed and lead weights added to the base of the frame to provide sufficient weight for penetration into the hard sand.

Diver observations of the frame during preliminary tests indicated that penetration occurred as expected and that the frame generally remained upright without sinking into the soft sediment to any significant degree. Tracking of the penetration marker generally indicated penetration equal to that measured through tension on the Kevlar line. However, on occasion, when measuring the sand cap, it became apparent that the frame lifted rather than the probe penetrating, causing the unit to tip over.

2.4 Suspended Sediment Measurements

An important aspect of site designation for the Field Verification Program is an evaluation of the potential for contamination from other disposal operations which might affect the measurement of biological parameters. Since future disposal operations were planned for points in the southwest corner of the CLIS site, the dumping of Quinnipiac River sediment at the MQR site provided an excellent opportunity to assess whether or not significant amounts of suspended material could be detected from that operation at the Black Rock site.

To accomplish this objective, the DAISY instrumentation array was deployed. This self-contained array, designed to provide reasonably long-term, in-situ observations of the suspended material field, consists of a basic data logger/logic control unit and two primary subsystems. The data logger controls sampling sequence, supplies power to the subsystems, and digitally records the output data. Storage tape cassettes permit sampling four times an hour for approximately 36 days. Conversion of the tapes produced by the Sea Data Model 651-8 data logger is affected using a Model 12A reader in combination with a Digi-Data magnetic tape drive.

The primary subsystems consist of an optical array to monitor suspended material concentrations, a savonius rotor current meter, a lapsed-time camera, and an assembly of mechanical water samplers to provide concurrent physical samples to supplement the optical observations. The optical array consists of two red-light transmissometers. Designed to be relatively insensitive to dissolved materials (particularly color-rich organics) and water matrix variations, each of these units provides an analog output proportional to the concentration of sediments suspended over a 10 cm path. Path length was specified following an examination of instrument sensitivity and examination of ambient suspended material concentrations and the characteristic variations expected at the FVP site. Output characteristics were defined following individual laboratory calibration of each instrument over a range of suspended material concentrations prepared using natural sediments obtained from the deployment area. Such calibrations are conducted prior to each deployment period and immediately after recovery. The latter calibrations are specifically intended to monitor instrument drift affected by battery aging and to detail the effects of biological fouling of the optical windows.

The current meter for the pre-disposal survey consists of a single savonius rotor and attendant compass and vane. The combination is positioned approximately 0.5 m above the sediment-water interface and is intended to monitor mean flow conditions.

For the post-disposal measurements, the savonius rotor current sensor was replaced by a two axis (x,y in the horizontal) electromagnetic current meter (Marsh McBirney Model 585 OEM). This modification was intended to improve system reliability and resolution and to reduce sensitivity to fouling and bearing wear induced by sediment accumulations.

Temperature was measured at two points on the vertical using protected thermistors housed in PVC pressure cases. Conductivity was monitored using a single sensor mounted just above the current meter. This sensor consists of a three electrode flow-through cell and associated electronics (Sea-Bird Model 4-01). The combination provides a frequency output proportional to conductivity. Conversion was affected by a counting network located within the digital data logger. These counts were subsequently converted to equivalent conductivity using an algorithm supplied by the manufacturer.

The instrumentation array was deployed at the FVP Center during the pre-disposal periods from 16 August 1982 to 8 April 1983. On 18 April 1983, the array was deployed at the 1000E station through 29 June.

2.5 Additional Instrumentation

Although the instrumentation described above provided most of the data used in this report, additional instrumentation was required to generate supporting information.

Most of the work accomplished on this program was conducted from the R/V UCONN, a 65 foot "T" boat converted for research by the University of Connecticut. She is fitted with an electric winch and a pneumatic boom for over-the-side operations and has sufficient lab space for electronic instrumentation. The UCONN was supported by the "EAST PASSAGE", a 26 foot Mon Ark workboat which was used for sampling within the harbors and to support diving operations at the disposal sites.

All navigation control for surveys, sediment sampling and REMOTS photography was provided by the SAI Navigation and Data Acquisition System, a computerized control unit interfaced to a Del Norte 540 microwave positioning system. The SAI system provides real time video displays of ship position relative to designated lanes or locations which substantially enhance the capability of the ship's helmsman to steer survey lanes within ±5 meters and to obtain replicate sediment samples within ±10 meters. This precision in ship control is an essential requirement for this program since the disposal mounds are quite small and spatial variability in measured parameters is relatively large. Using calibration techniques established under the DAMOS program, recorded position accuracies within the CLIS disposal site are ±1-2 meters.

A Klein Side Scan Sonar was used to evaluate the distribution of dredged material over the Cap Sites and to assess potential interference from other disposal operations. The system consisted of a 100kHz towfish, nominally positioned 10 meters above the bottom, connected to a standard Klein wet paper recorder. The range scale was set to 75 meters and surveys were conducted over lanes 1000 meters long with a spacing of 100 meters (Fig. III-2-5).

Sediment sampling at the disposal sites was accomplished using a stainless steel Smith-MacIntyre grab sampler or a 3 meter long gravity corer supplied by the R/V UCONN. All samples were stored at 4°C and all cores were kept in a vertical orientation until sliced at the NED sediment lab.

3.0 RESULTS

3.1 Bathymetry

The pre-dispsoal survey in December 1982 indicated the expected lack of topography typical of the CLIS site (Fig. III-3-1) that was seen in the site selection surveys (DAMOS Contribution #23).

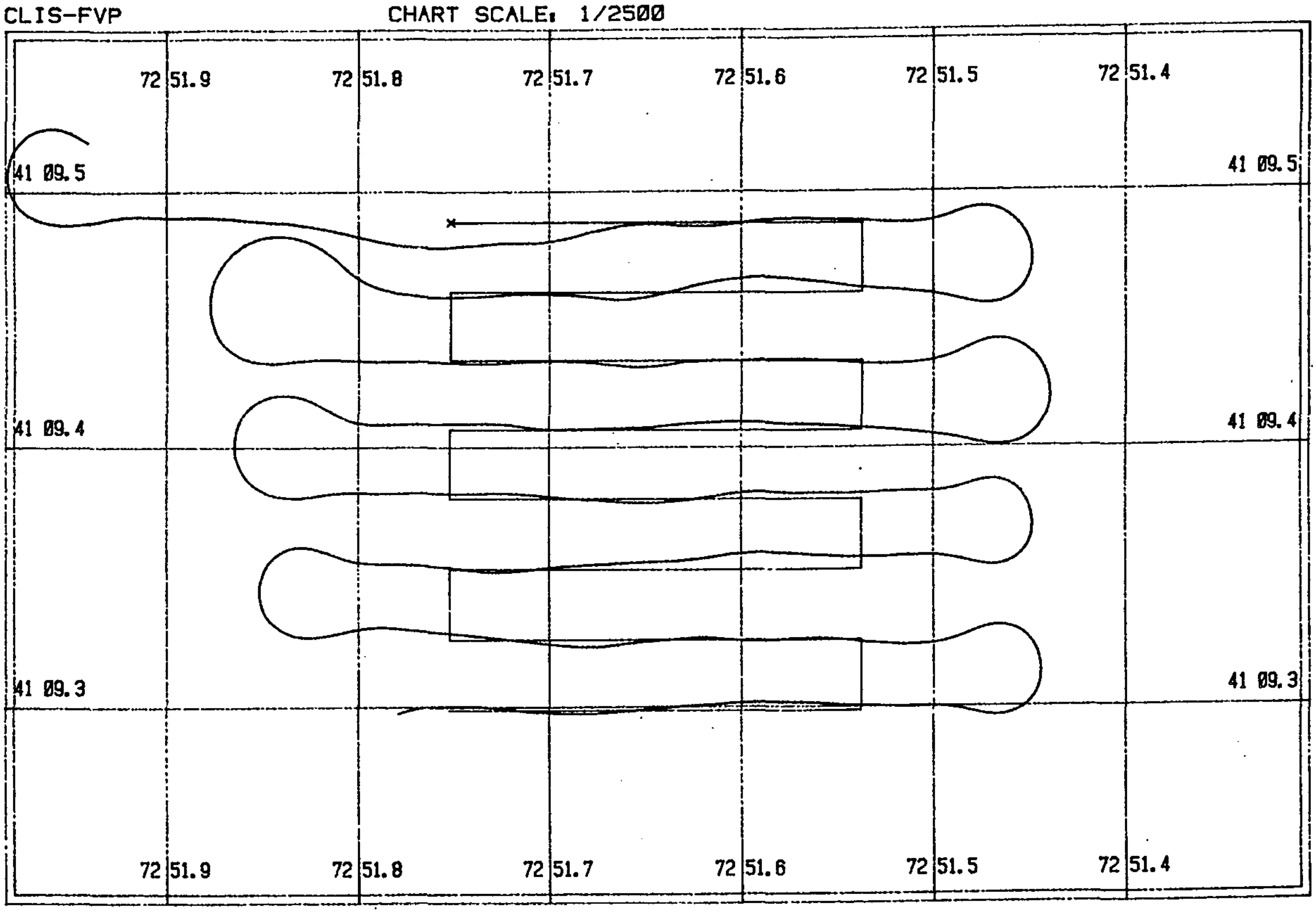

FIGURE III-2-5. FVP Side Scan Survey grid with Ship's Track.

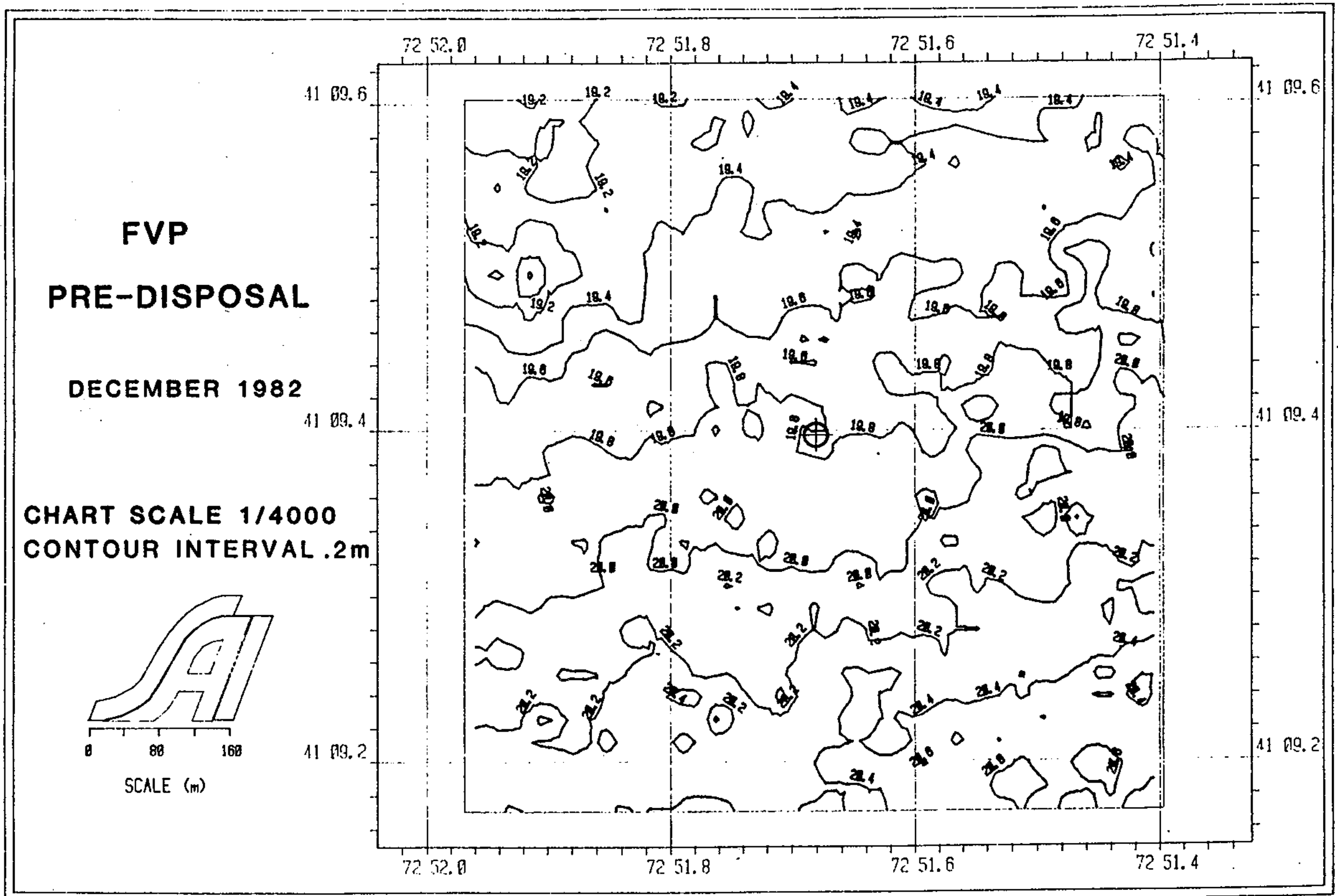

FIGURE III-3-1

Disposal of contaminated Black Rock sediment was carefully monitored at the FVP site through a series of interim surveys. The first of these, on 28 April 1983, was conducted to assess the conditions of the site as the first loads of sediment were deposited. The results of this survey (Fig. III-3-2) indicated that a small mound had formed in the vicinity of the disposal buoy and, therefore, that additional disposal should create the desired mound.

A second interim bathymetric survey and associated side scan survey were conducted on 5 May 1983, after the disposal of approximately 35,000m^3 of dredged material had been completed. The results of this survey (Fig. III-3-3) were also satisfactory as a small mound approximately 150m in diameter had formed at the buoy with a topographic relief of more than one meter. The formation of the mound during disposal is shown in the lane profiles for lanes 13 through 20 (Fig. III-3-4a,b).

The immediate post-disposal survey on 19 May revealed a relatively small deposit (Fig. III-3-5) approximately 200m by 100m, with the major axis oriented in an east-west direction. When viewed on the contour difference chart (Fig. III-3-6), the topographic expression is slightly larger with a thin layer of material extending along a NE/SW direction. The maximum thickness of the mound is approximately 1.8 meters.

Sediment samples and diver observations of the FVP mound indicated that the center portion of the Black Rock material consisted of a mixture of coarse grained materials including a gray sand, cohesive clay clumps up to 50cm in diameter, and a matrix of soft, high water content, black organic silt with a strong odor and obvious presence of oil and grease. At a relatively short distance from the center (100-150m), the thickness of this material was reduced substantially to a layer several centimeters thick which was composed of a fine-grained, black organic silt, with virtually no coarse material, but a continued high water content and a strong odor. At distances approaching 400m from the center, this layer had thinned to a slight veneer over the natural bottom and the margin of visible dredged material was between 400 and 500 meters in the east-west and 300-400 meters in the north-south directions.

Three post-disposal surveys were conducted in June, July and August 1983 (Figs. III-3-7 through III-3-9). Profiles for lanes 13 to 20 in June are shown in Figure III-3-10a,b. The contour difference chart for the May to July period (Fig. III-3-11) indicates a depth increase in the center of the mound. This apparent decrease in the height of the mound is a likely result of initial reworking and consolidation of the dredged material. There were no changes in the mound topography during the July to August period (Fig. III-3-12).

FVP
INTERIM

APRIL 1983

CHART SCALE 1/4000
CONTOUR INTERVAL .2m

0 80 160

SCALE (m)

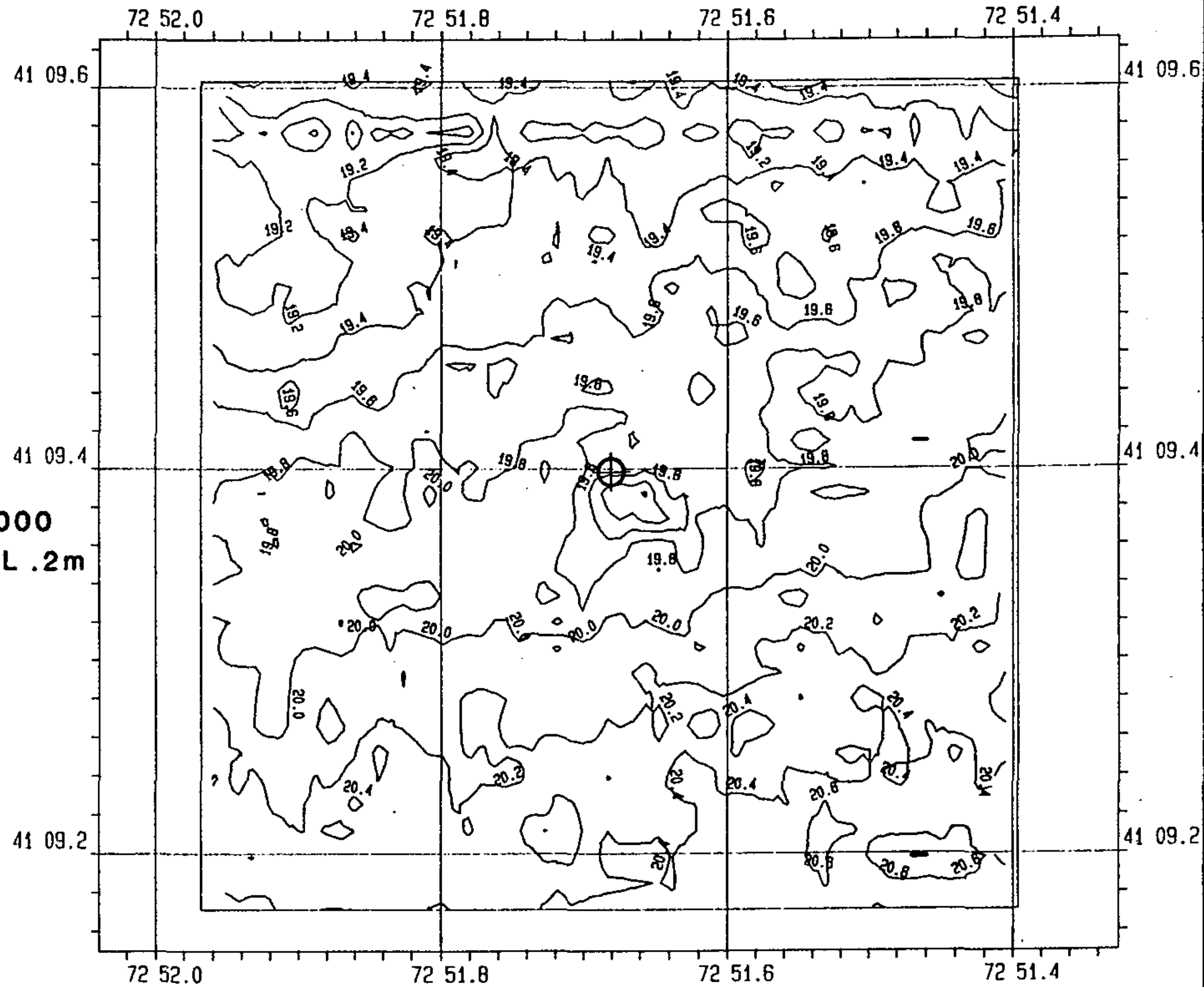

FIGURE III-3-2

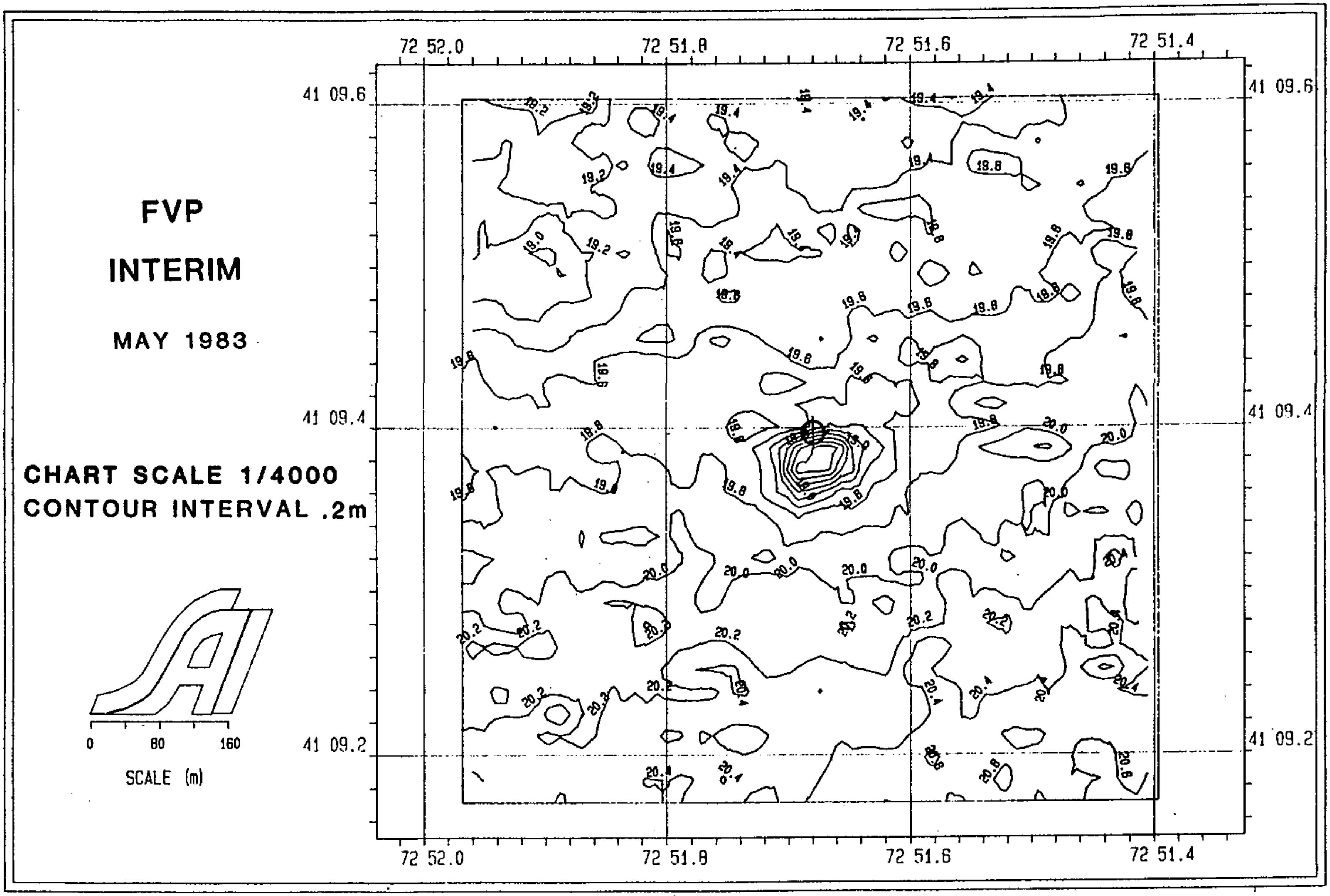

FIGURE III-3-3

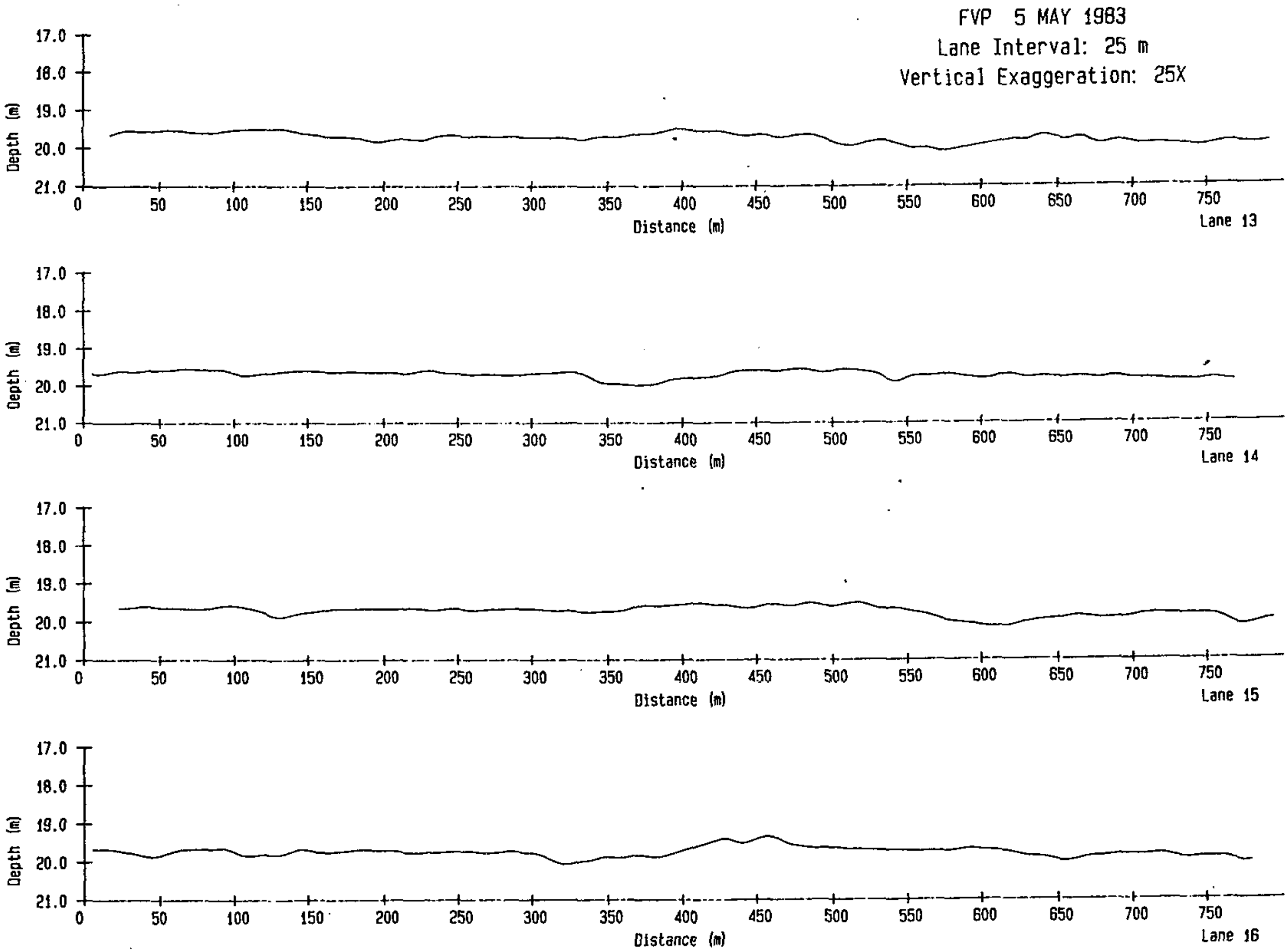

FIGURE III-3-4a. Bathymetric profiles for lanes 13 to 16 and 17 to 20, May 1983.

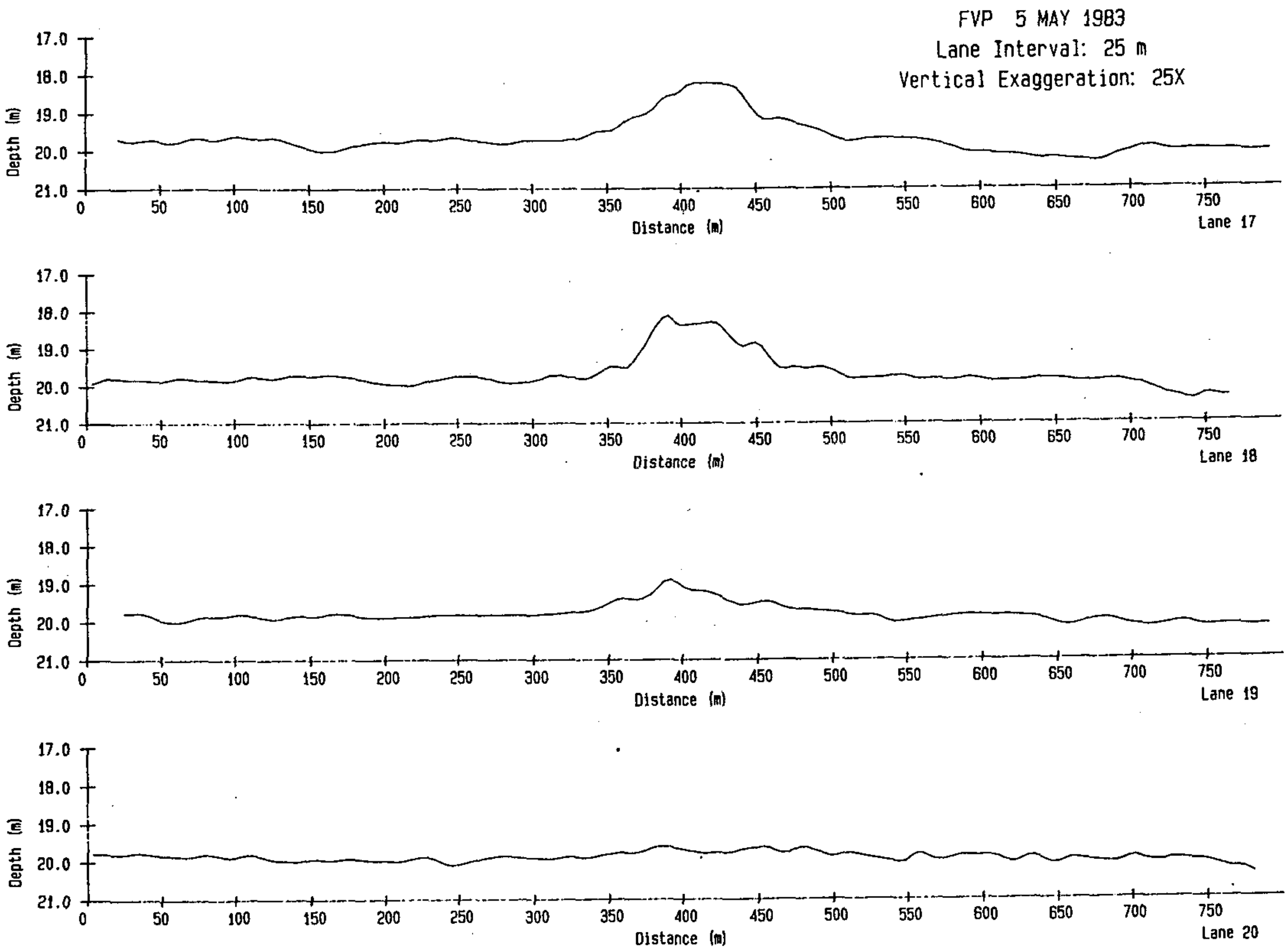

FIGURE III-3-4b

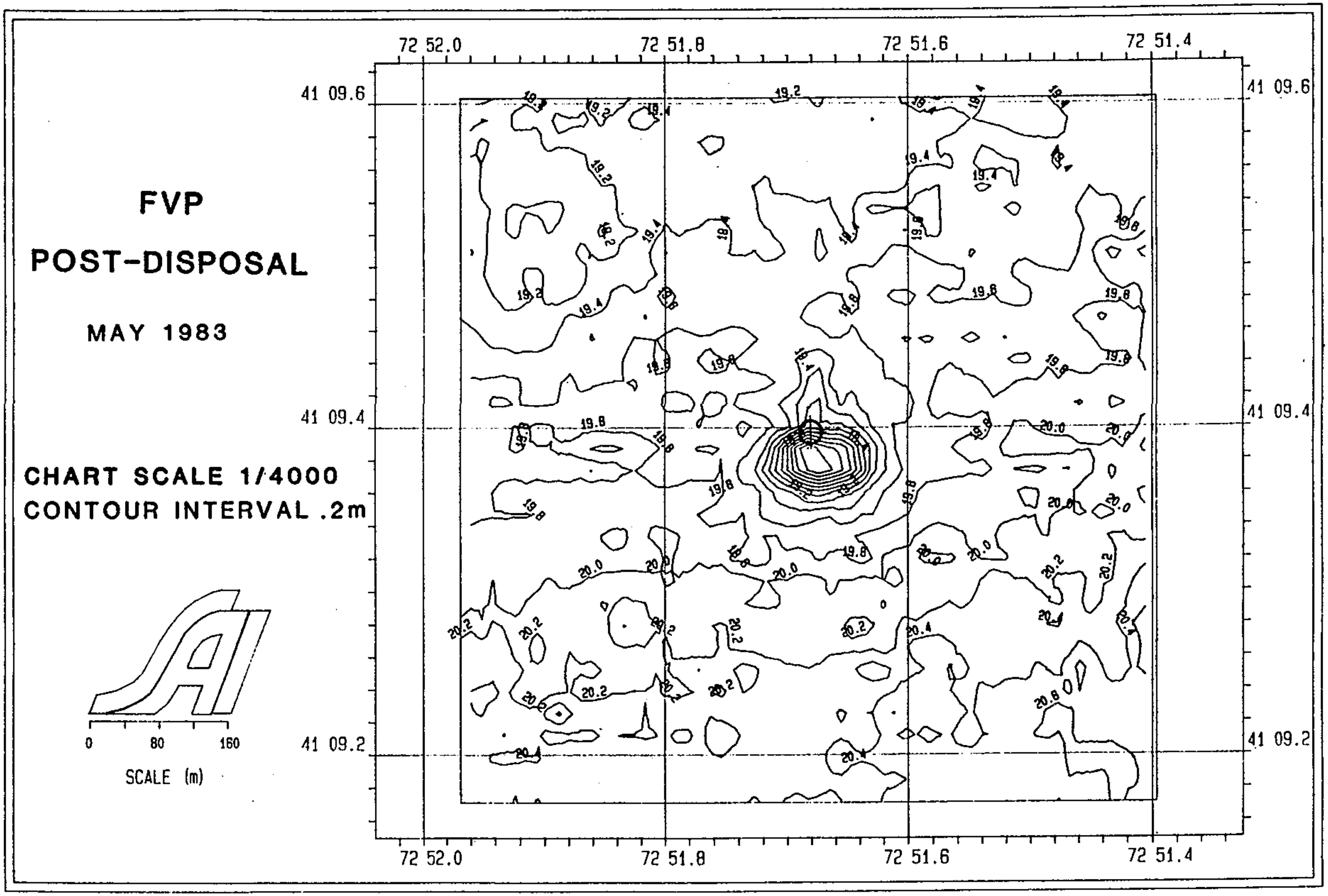

FIGURE III-3-5

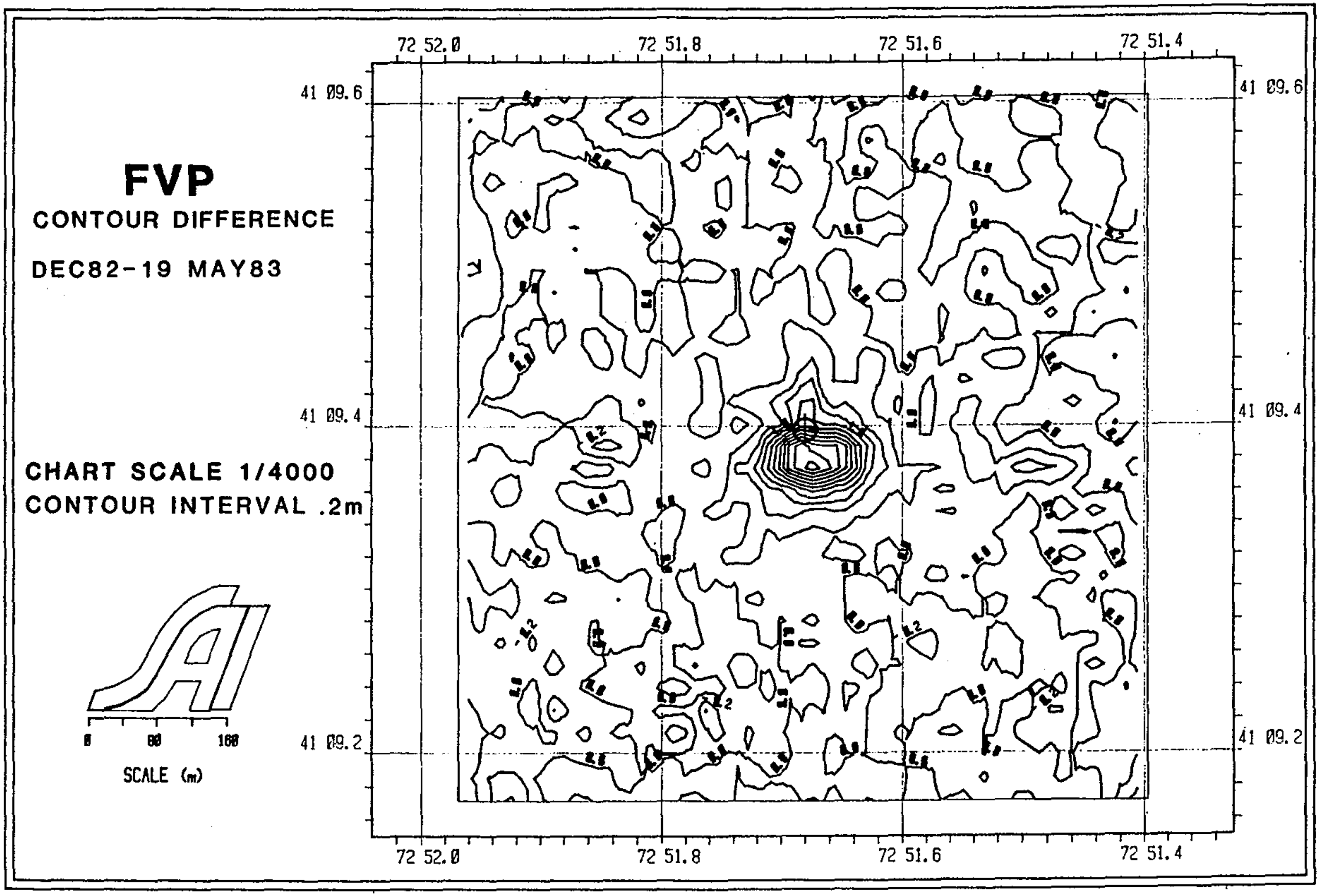

FIGURE III-3-6

FVP
POST-DISPOSAL
JUNE, 1983

CHART SCALE 1/4000
CONTOUR INTERVAL .2m

0 80 160
SCALE (m)

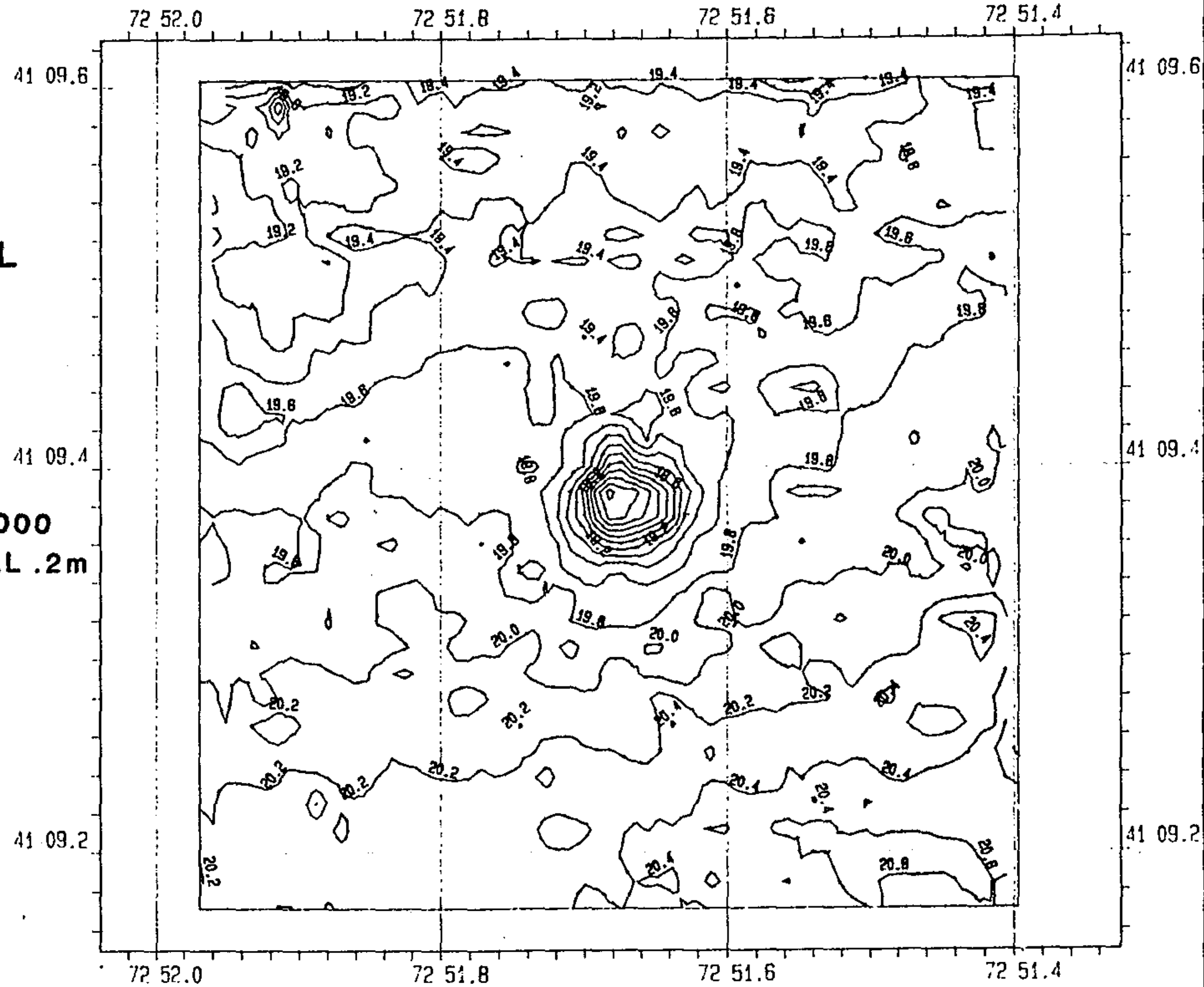

FIGURE III-3-7

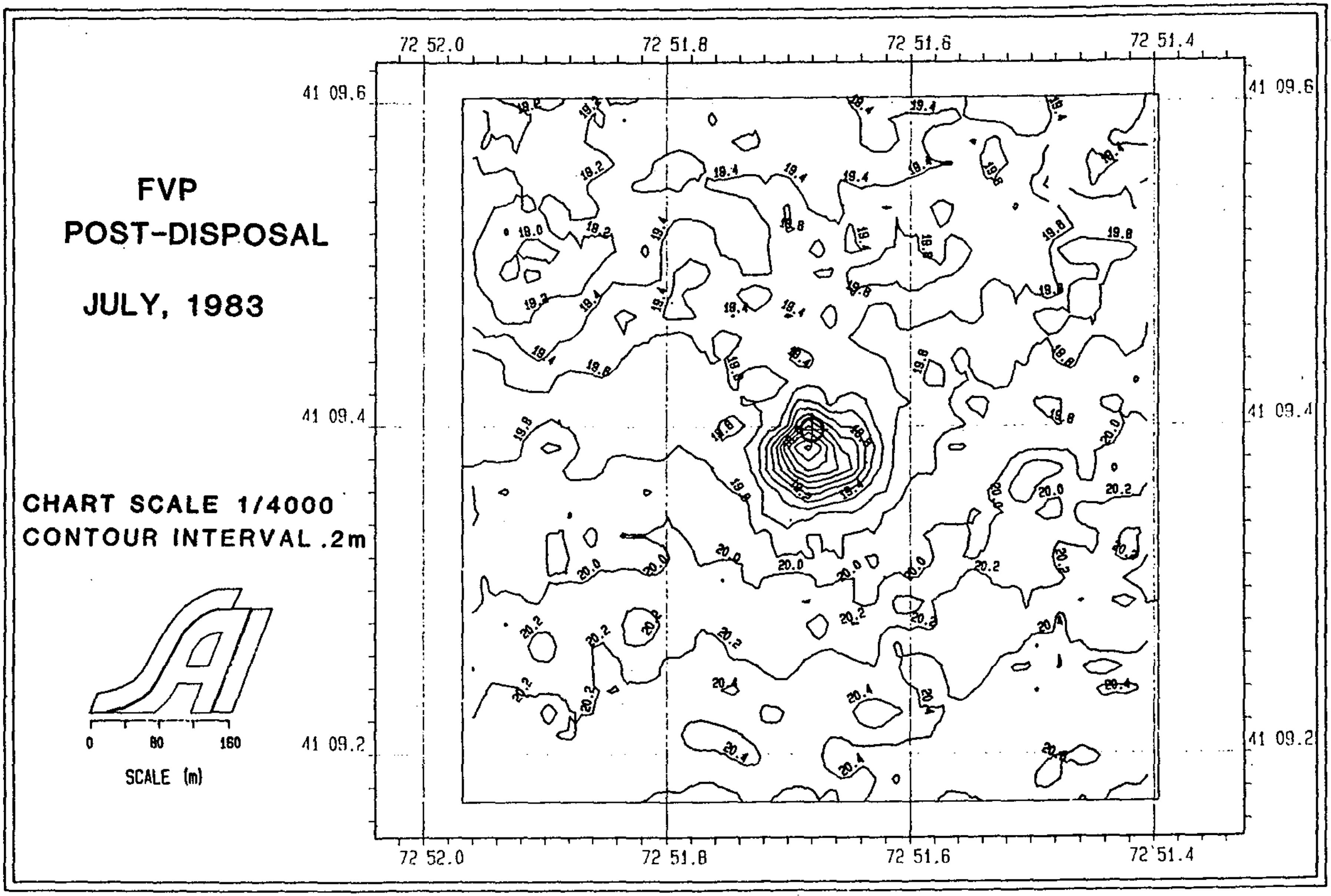

FIGURE III-3-8

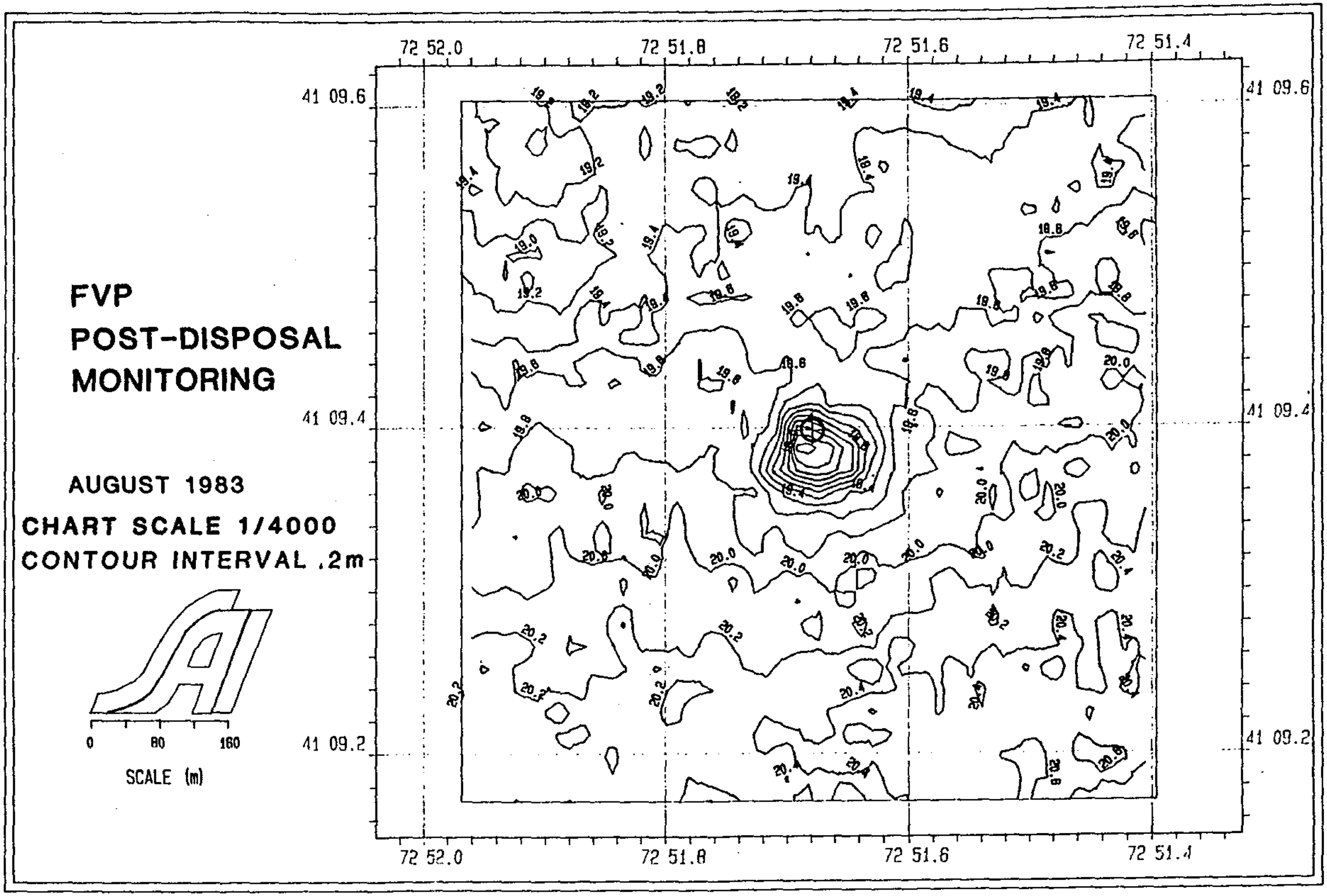

FIGURE III-3-9

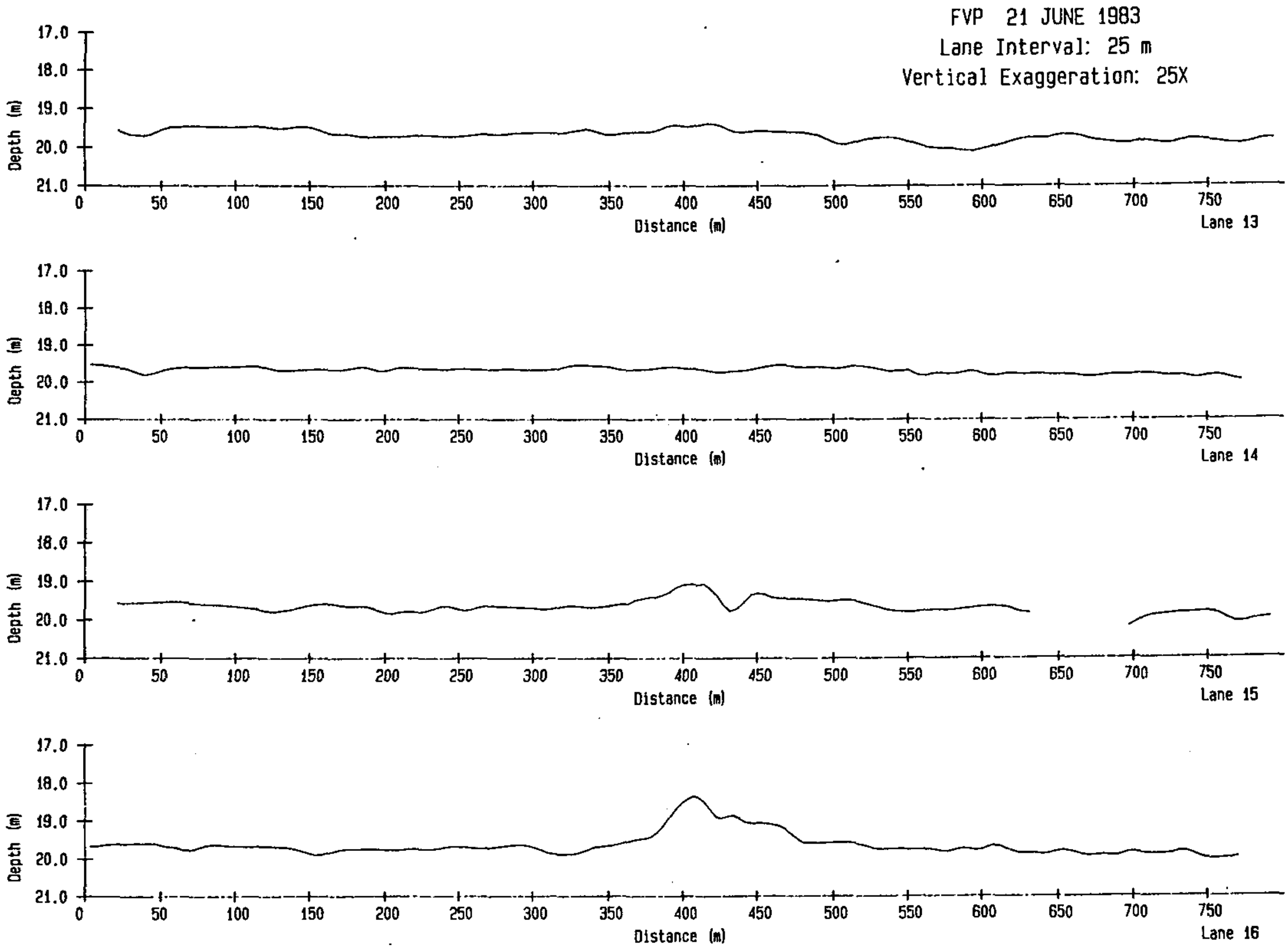

FIGURE III-3-10a. Bathymetric profiles for lanes 13 to 16 and 17 to 20, June 1983.

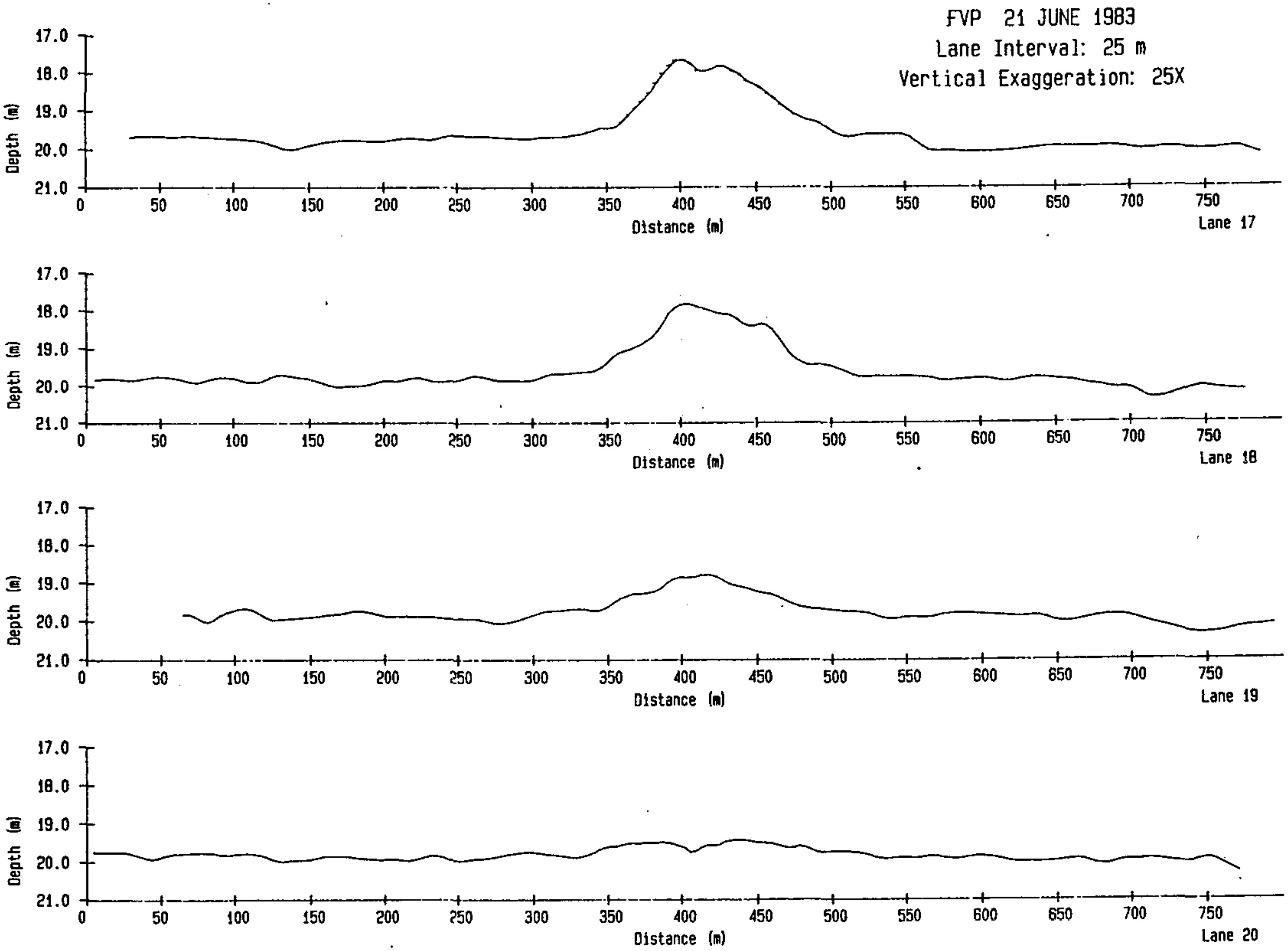

FIGURE III-3-10b

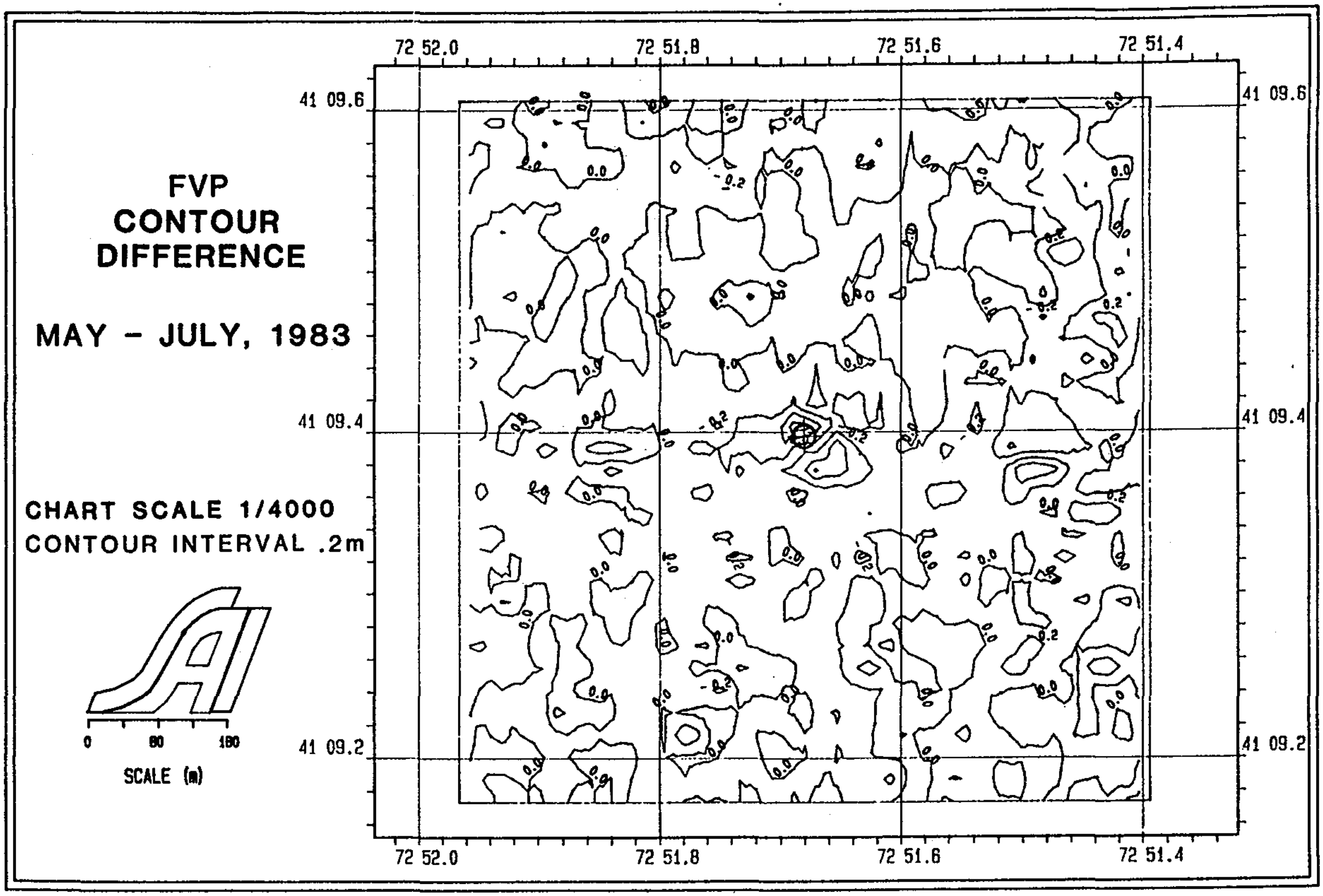

FIGURE III-3-11

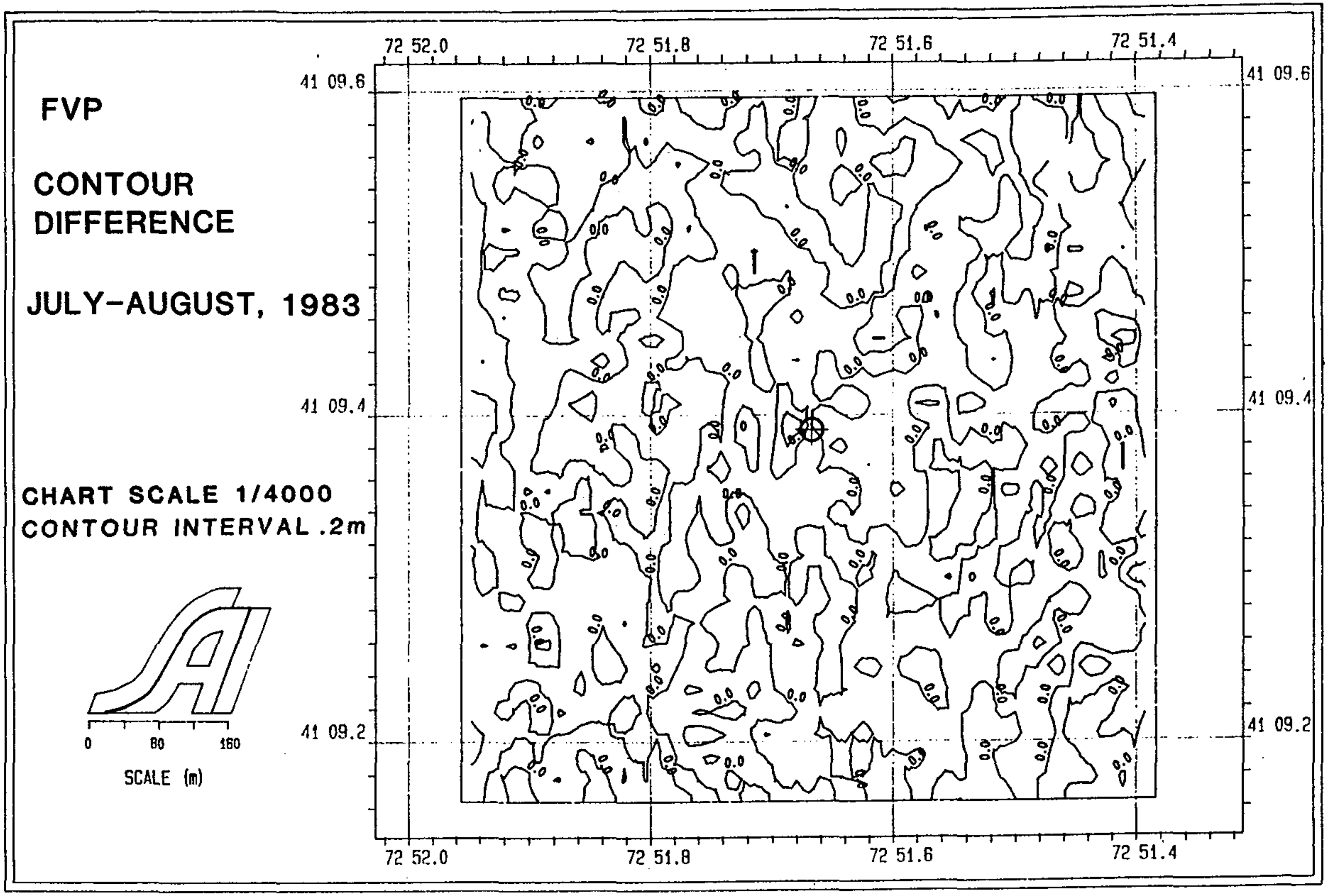

FIGURE III-3-12

3.2 Side Scan Sonar

A pre-disposal survey was conducted on 26 April, then on 5 May during disposal and again on 10 June, 27 July and 8 September 1983.

The purpose of the pre-disposal survey was to map any apparent differences in bottom type and to locate any indications of previous disposal in the site. The area surveyed by side scan was centered at the designated disposal point and consisted of 11 lanes, 1000m long, spaced 200m apart.

The survey revealed a major change in bottom conditions from the western margin of the site toward the east. On the western edge, the bottom was much more variable with frequent patches of strong reflecting sediment and obvious detritus. Toward the east, the reflectance of the surface sediment decreased, there were fewer detritus outcrops, and the bottom was dominated by a series of troughs oriented in an east-west direction parallel to the tidal current flow (Fig. III-3-13).

These records indicate a continual spillage of debris taking place in the western region from disposal operations over a long period of time. Such conditions appear common in the vicinity of disposal points where a standard approach lane is designated, as was the case with the Stamford/New Haven project.

The eastern side of the survey area is characterized by relatively strong reflections from a series of troughs or furrows in an east-west direction. These troughs, oriented parallel to the dominant tidal flow direction, were not observed on previous surveys of the CLIS site, including the cap sites. They have been identified in other tidal regions where deposition of fine grained sediments was occurring.

Formation of the furrow features is thought to be the result of two factors: helical secondary flow patterns and localized abrasion or scour around coarser particles. The helical flow patterns have been shown to develop in well-mixed bottom boundary layers associated with short-term, non-steady tidal flows similar to those that occur in Long Island Sound.

The interim survey, shown in Figure III-3-14, again found the east-west directed furrows to be present. The initial disposal mound is evident as an area of strong reflectivity. An interesting feature, not seen in previous disposal operations, is the presence of what appears to be a disposal trail. This trail probably results from scow leakage while either approaching or leaving the disposal buoy.

Side scan records over the post-disposal period showed a general decrease in the intensity of the reflected signal associated with the disposal mound (Figs. III-3-15 to III-3-17). This can be attributed to general reworking of the sediment and deposition of fine material on the surface of the disposal mound. This phenomenon was also observed by divers who noted the development of an oxidized surface layer and initial reworking of

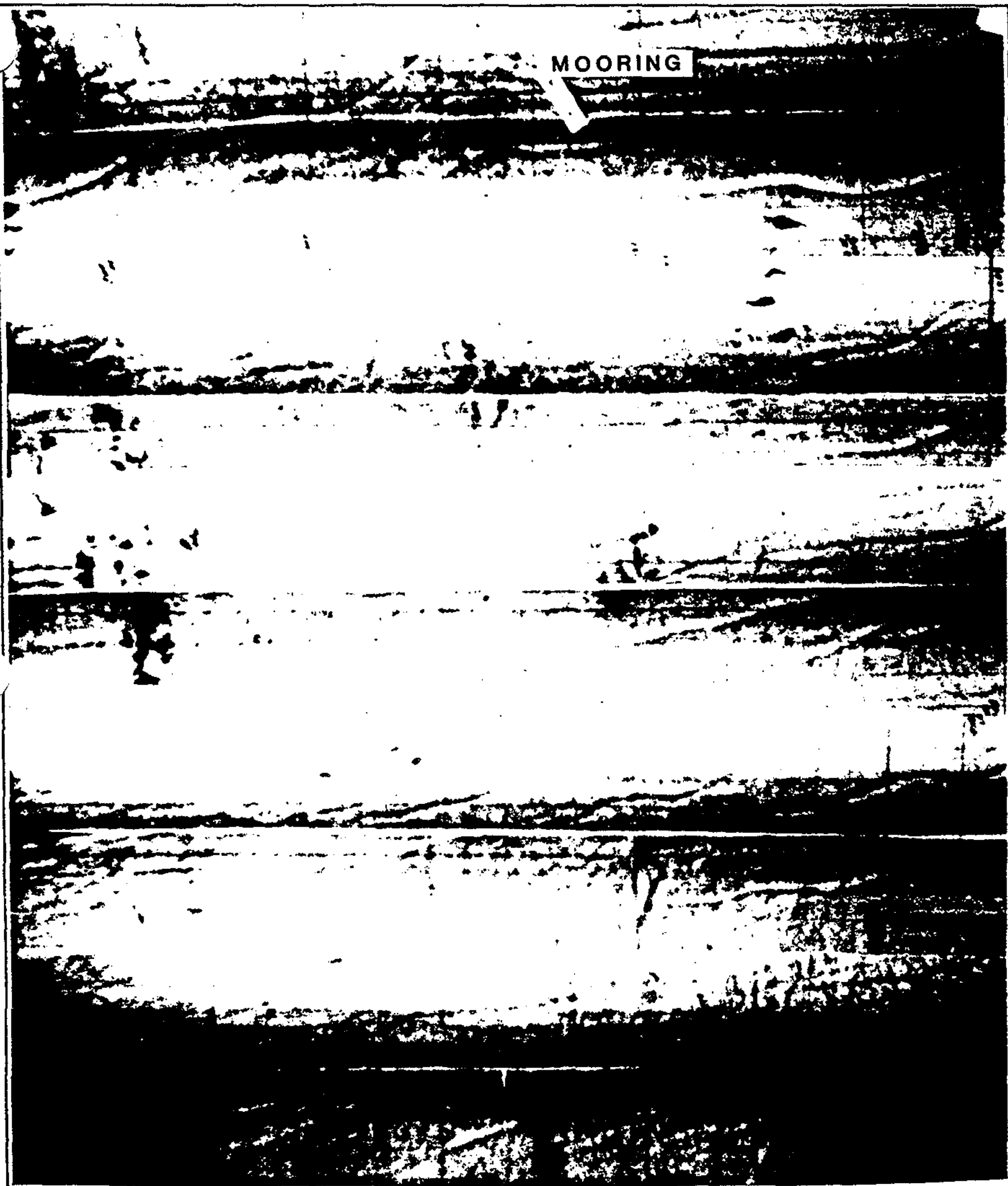

FIGURE III-3-13. Side Scan Survey, April 1983.

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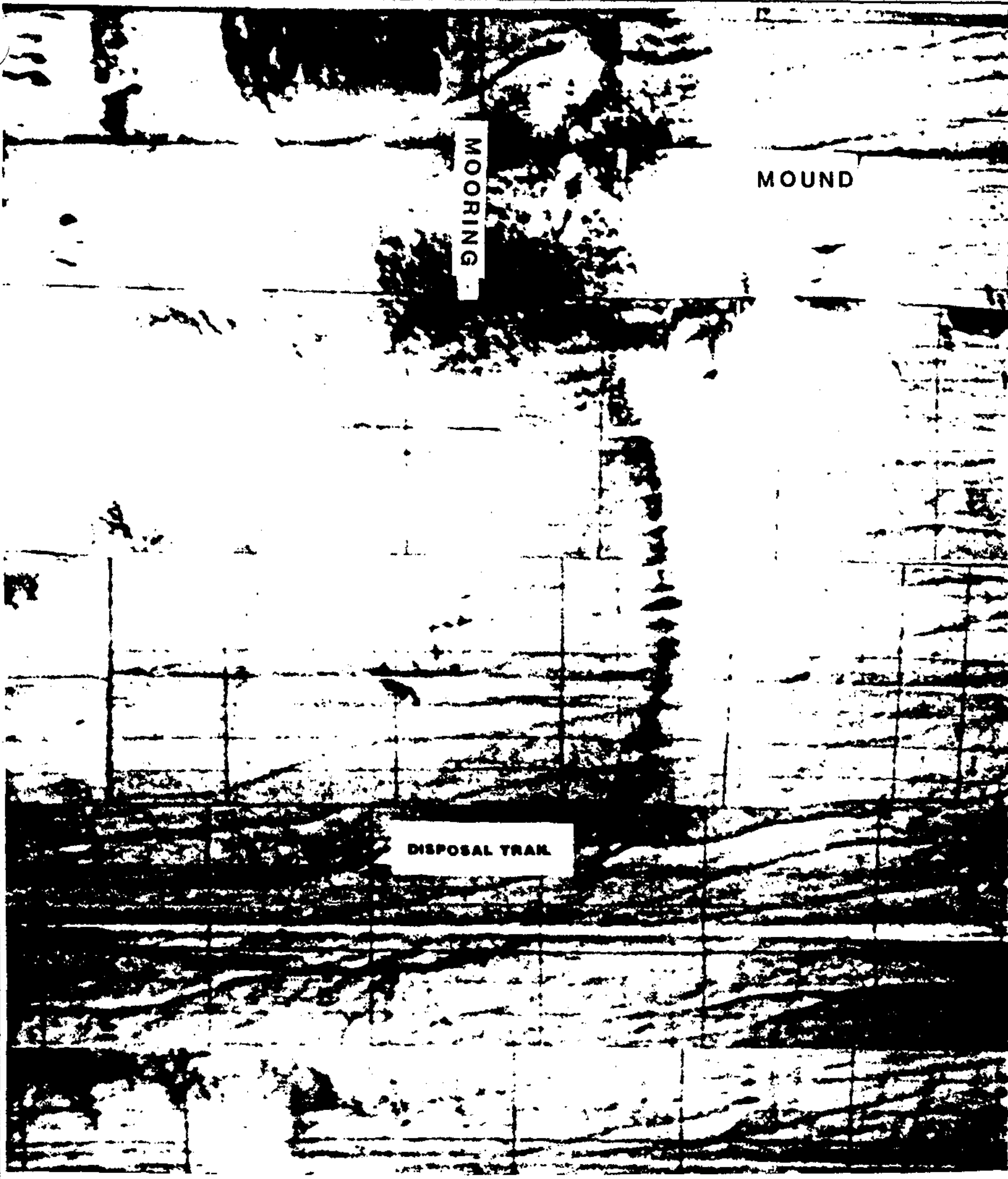

FIGURE III-3-14. Side Scan Survey, May 1983.

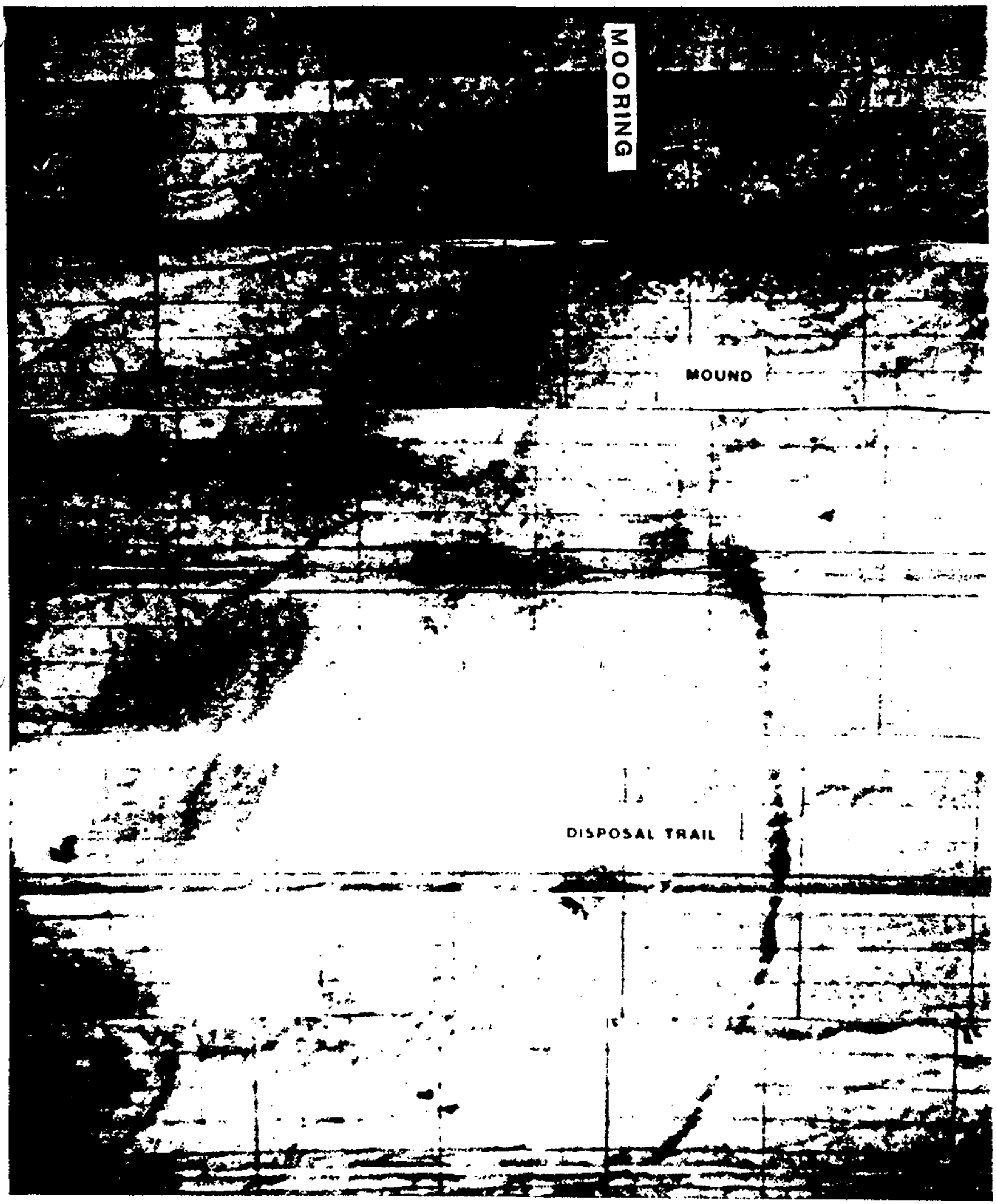

FIGURE III-3-15. Side Scan Survey, June 1983.

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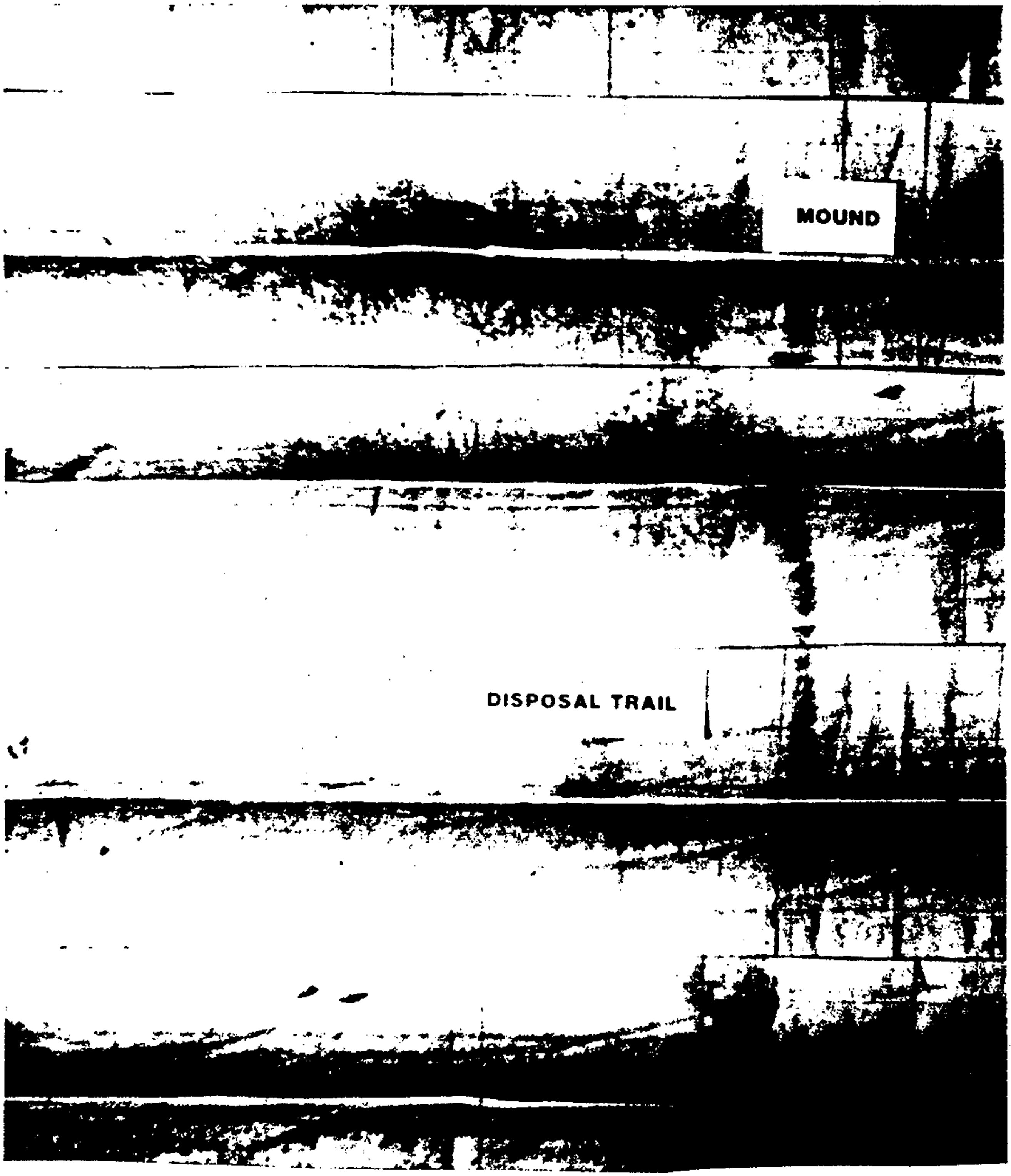

FIGURE III-3-16. Side Scan Survey, July 1983.

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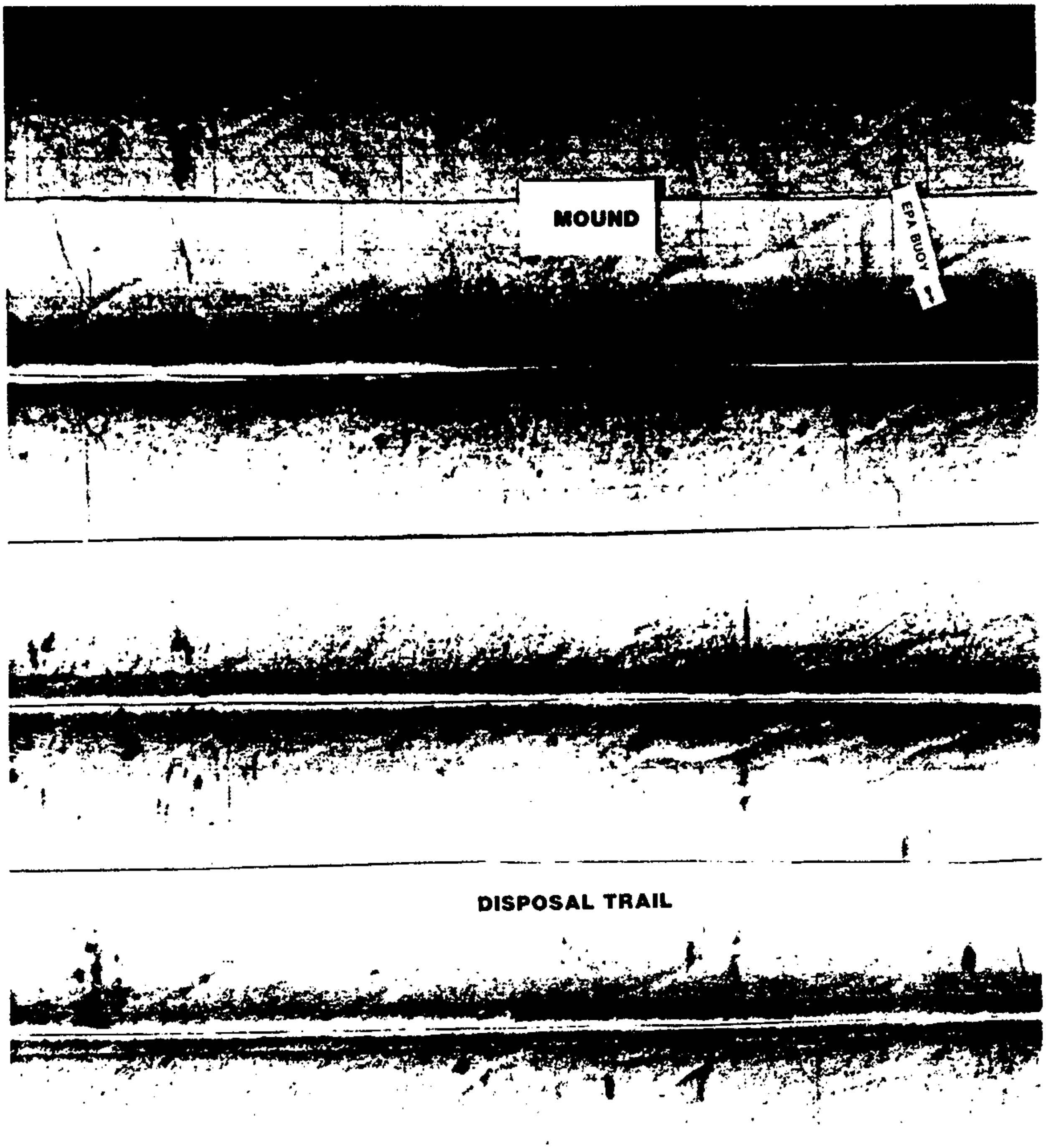


FIGURE III-3-17. Side Scan Survey, September, 1983.

SAIC

the banks of the mound by large epifauna and the usual infauna associated with the Central Long Island Sound area.

3.3 REMOTS

The REMOTS interface camera and analysis system has two applications in the DAMOS program. The first is as a reconnaissance tool to efficiently map the areal distribution of dredged material immediately following disposal. The rapid data analysis (24-48 hours) allows for the most cost-effective post-disposal sampling. The second application is as a monitoring tool to assess long-term changes in conditions of the benthic habitat.

3.3.1 Pre-Disposal Surveys

A second pre-disposal survey was conducted on 15 March 1983. A north-south and east-west sampling grid was established with its center located near 41°09.4N, 72°51.6W. Fifteen stations were occupied on the cross-shaped sampling grid (Fig. III-3-18). This grid design and station locations were selected on the basis of a more intensive (51 stations) REMOTS survey conducted at this site in August 1982 (Morton et al., 1982). Twelve station replicates were also collected at the reference station CLIS-REF (Fig. III-3-18).

Examination of the data collected in March 1983 for RPD depths, boundary roughness, major sediment grain-size modes, prism penetration depths, faunal successional stages, and REMOTS habitat indices describes the patchiness of the benthic habitat. The comparison of these variables with those mapped in August 1982 are limited to the 15 common stations in these surveys. Site conditions at the CLIS-REF station were also compared over the same period of time.

All station replicates show the surveyed area to consist of a major textural mode equal to, or less than, coarse silt (62 micrometers). All of the surveyed area, including the CLIS-REF site, is classified as silt-clay. Subordinate textural modes fall within the finer sand or coarser fraction depending on the quantity of shell present. These results are the same as described for August 1982.

The redox depth values at the FVP site and CLIS-REF station are normally distributed with a major mode at 4.0 to 4.5cm (Fig. III-3-19). The August 1982 data are also unimodally distributed about a major mode of 4.0 to 4.5cm. No differences were found between the FVP site and CLIS-REF station on either sampling date. Table III-3-1 gives the results of student's t-test for the August 1982 - March 1983 mean RPD depths.

The mean RPD depth at each station at the FVP site for March 1983 is given in Figure III-3-20. The differences between the maximum and minimum RPD as measured between the three station replicates is shown in Figure III-3-21. Those stations with a relatively large difference reflect within station faunal

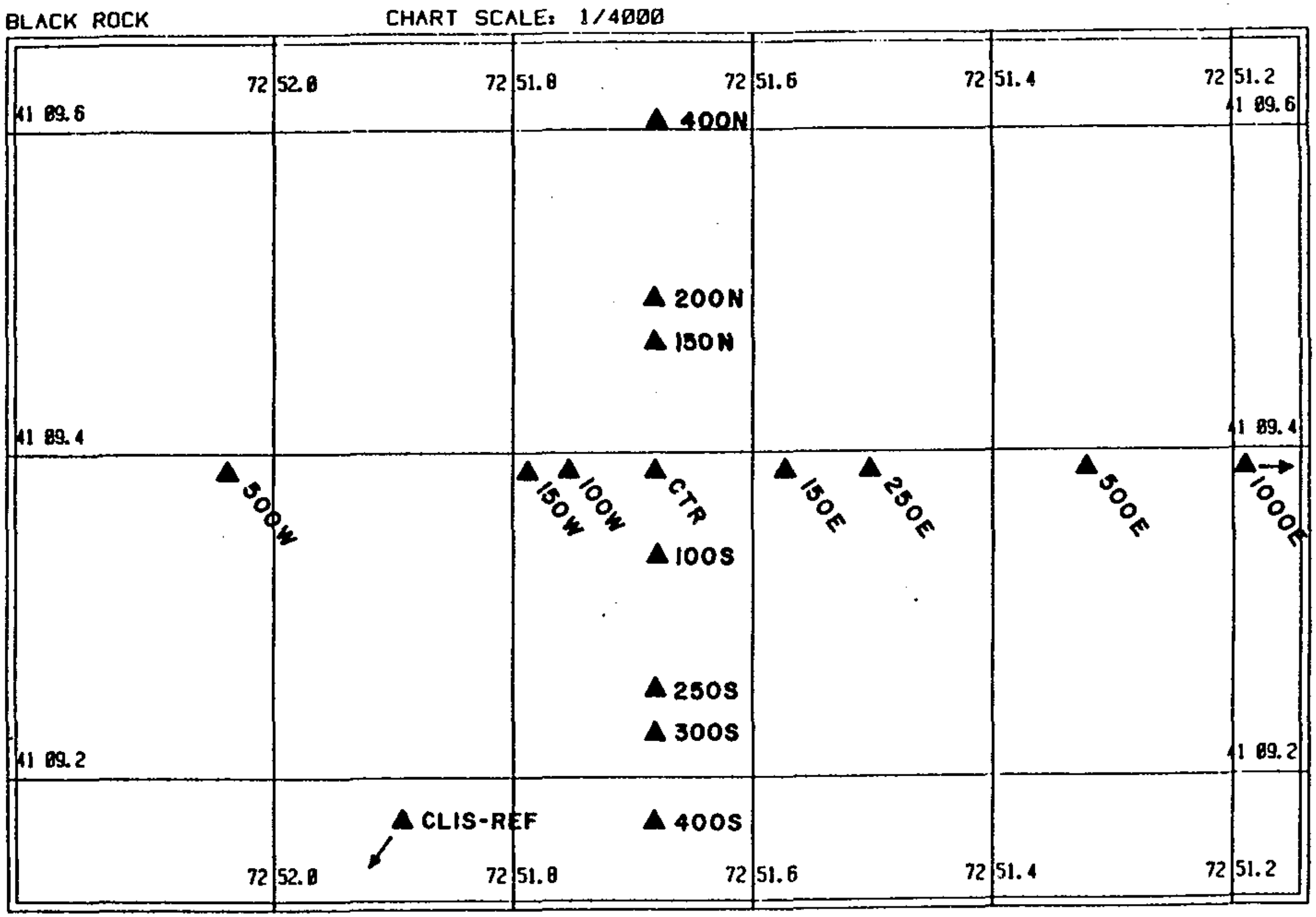


FIGURE III-3-18. REMOTS Sampling Locations for March 1983.

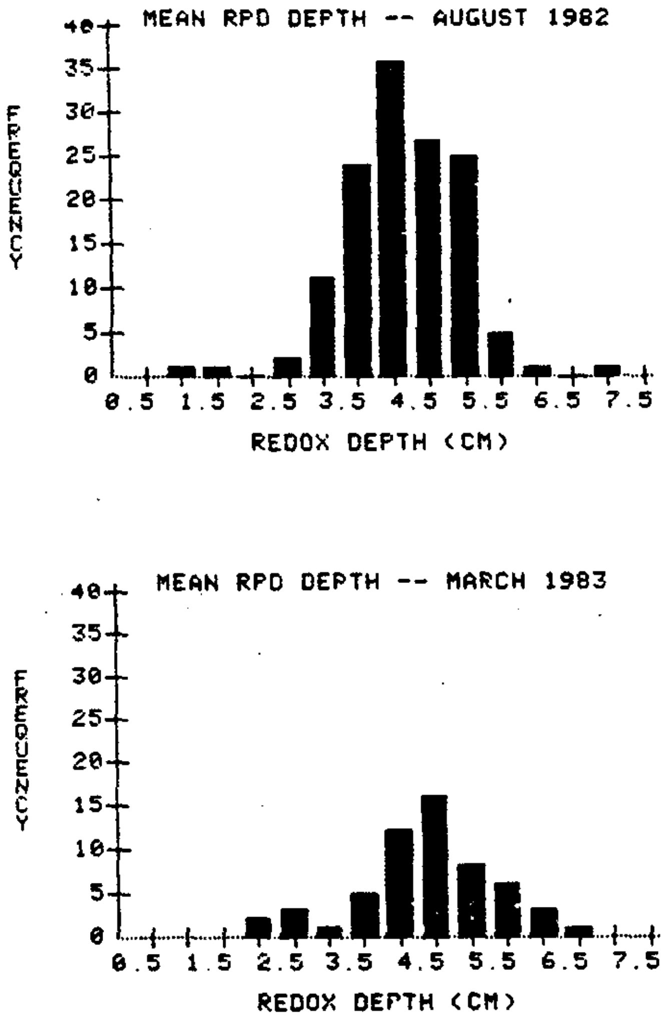


FIGURE III-3-19. Comparison of histograms for RPD depth (predisposal conditions) for August, 1982 and March, 1983 (n = 135 for August; n = 57 for March 1983). Class intervals were constructed as follows; e.g. all values from 0.51 to 1.00 are plotted at 1.00, all values from 1.01 to 1.50 are plotted at 1.50, etc.

TABLE III-3-1

Student's T-Test of Mean RPD Depths Between 8/82 and 3/83. No CLIS-REF Station Data are Included in This Table Because of Its Smaller Sample Size (n=15).

Sample	N	X RPD Depth (cm)	Std. Dev.
AUG 82	44	3.76	0.97
MAR 83	45	4.21	1.01

t (87 deg free.) = 2.14, p=<.05, Null Hypothesis Accepted

Student's T-Test of Mean Boundary Roughness Between August 1982 and March 1983. FVP site. No CLIS-REF Data Included.

Sample	N	X Roughness (cm)	Std. Dev.
AUG 82	44	0.71	0.24
MAR 83	44	0.83	0.45

t(86 deg. free.) = 1.64, p=>0.20, Null Hypothesis Rejected

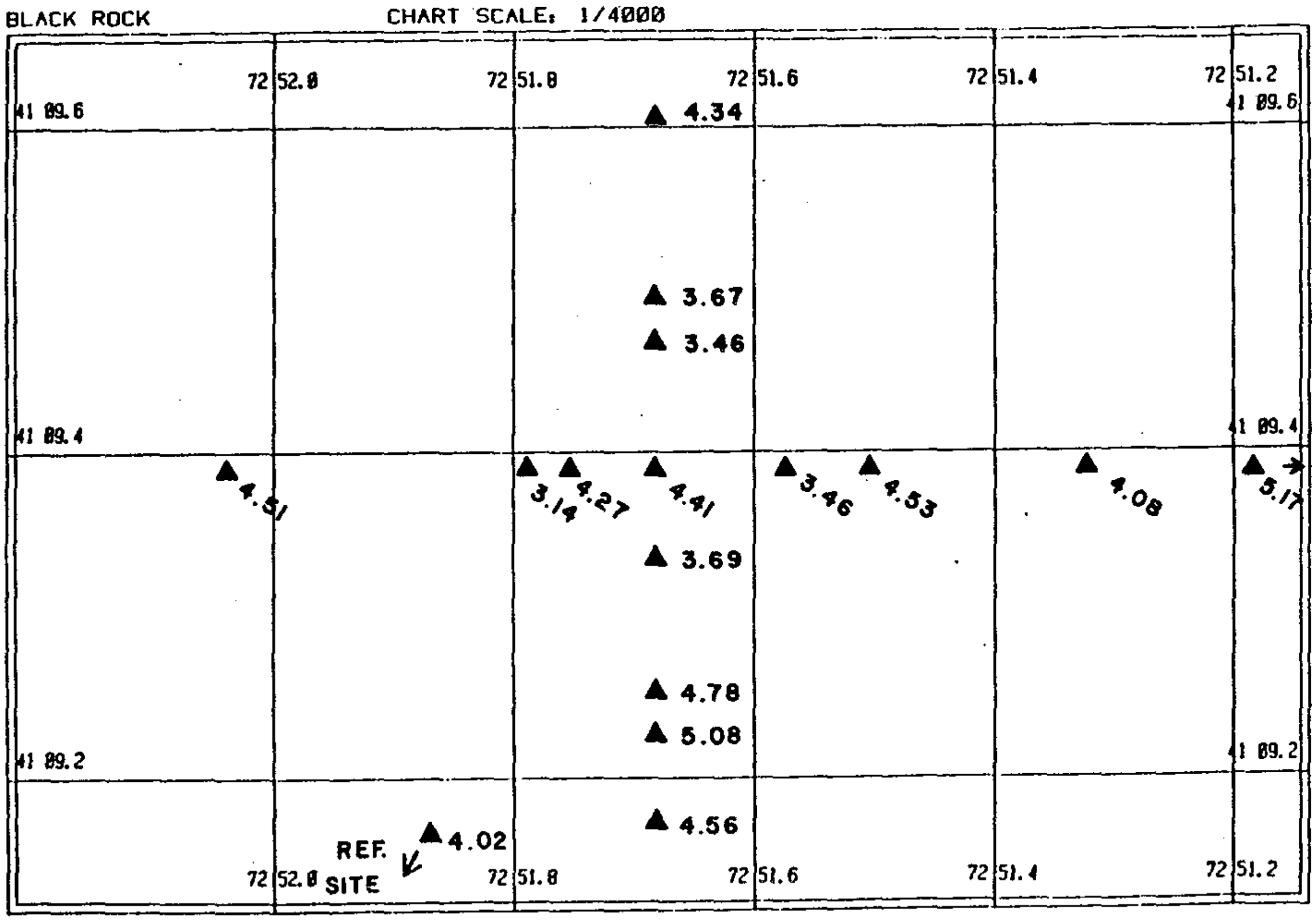


FIGURE III-3-20. REMOTS[tm] mean RPD depths at the sampling localities for March 1983. Station values are the mean of three replicates except for CLIS-REF site, where n = 12.

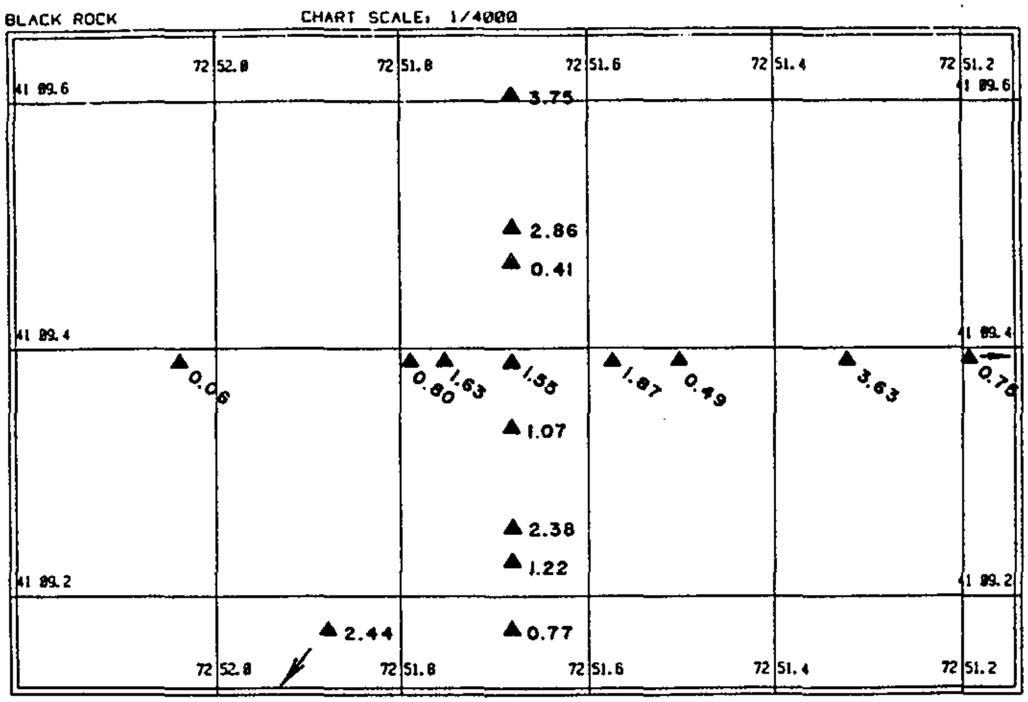


FIGURE III-3-21a. Within station difference between maximum and minimum RPD values, a measure of faunal patchiness.

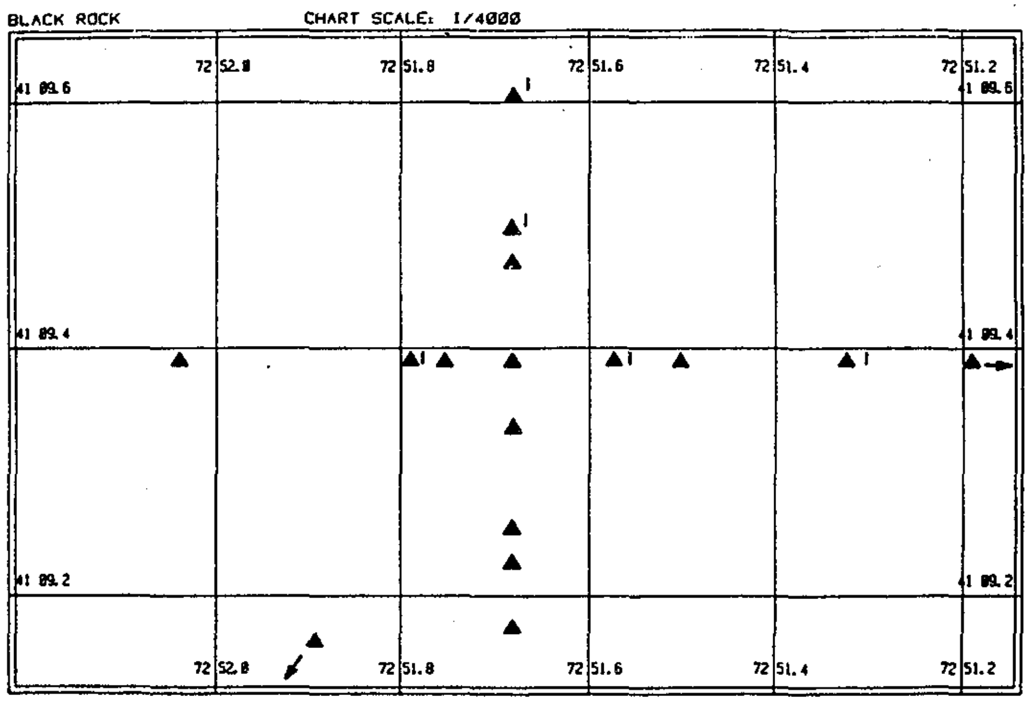


FIGURE III-3-21b. The number of station replicates with RPD depths less than 3.14 cm. These replicates represent either retrograde successional seres or are surficially eroded.

patchiness (local differences in the efficiency of fluid bioturbation) or local erosion of the upper zone of the aerated sediment surface. Past work has shown that RPD depths of less than 3 cm reflect either surficial erosion of a Stage III sere or represent a pioneering (Stage I-II) sere. The location of stations which have station replicates with RPD values equal to, or less than, 3.14 cm are shown in Figure 3-21b. Stations 200N, 150W, and 500W had replicates of 3.14 cm in both August 1982 and March 1983.

The REMOTS images provide independent evidence for surficial erosion, such as the presence of bedforms, mud clasts, truncated redox boundaries, and shell lag deposits. Stations which display these features are shown in Figure III-3-22. The data mapped in Figures III-3-21b and III-3-22 indicate that the following stations, which show a shallow redox depth in at least one replicate, could have experienced local scour and erosion of the redox: CTR, 400N, 200N, 500W, 250E, 100S, and 300S.

The boundary roughness values for both August 1982 and March 1983 are normally distributed and have a major mode of 0.4 to 0.6cm (Fig. III-3-23). Table III-3-1 gives the results of student's t-test of mean boundary roughness values between the two sampling dates. The t-test indicates that the sample means are not similar at a confidence level of 95%.

The mean REMOTS habitat indices for the FVP stations and CLIS-REF station are given in Figure III-3-24. The index has a potential range of -10 to +11. All mean values are at least 8.7 and most fall above 9.0. This distribution of indices is similar to that described for the FVP site and CLIS-REF station in August of 1982. These values represent a benthic habitat of high quality, i.e. an area of low physical, chemical or biological disturbance.

Of those five stations which have habitat values less than +10, (400N, 200N, 150E, 500E, 150W), three show local evidence of surficial erosion (400N, 200N, and 150W) (Fig. III-3-22). This local erosion causes lower habitat index values by decreasing the mean RPD depth and/or by promoting a retrograde succession. Both the RPD depth and successional stage parameters determine the numerical value of the habitat index.

In summary, the persistently deep RPD depth frequency distribution over the period August 1982 to March 1983 deserves special comment. With declining water temperatures over this period (delta t of 20^{o}C), a 2 to 3 fold decrease in the metabolic activity of infaunal benthos is expected. This temperature and metabolic decrease is associated with a decline in the rate at which oxygenated water is pumped into the bottom via tube and burrow openings. One might expect a "rebound" in the RPD as irrigation activity declines. However, microbial activity, as well as COD and BOD within the sediment column, also decrease with declining water temperature. Therefore, a deep redox may exist within the bottom even though bioturbational activity is negligible below ambient water temperatures of 8^{o}C

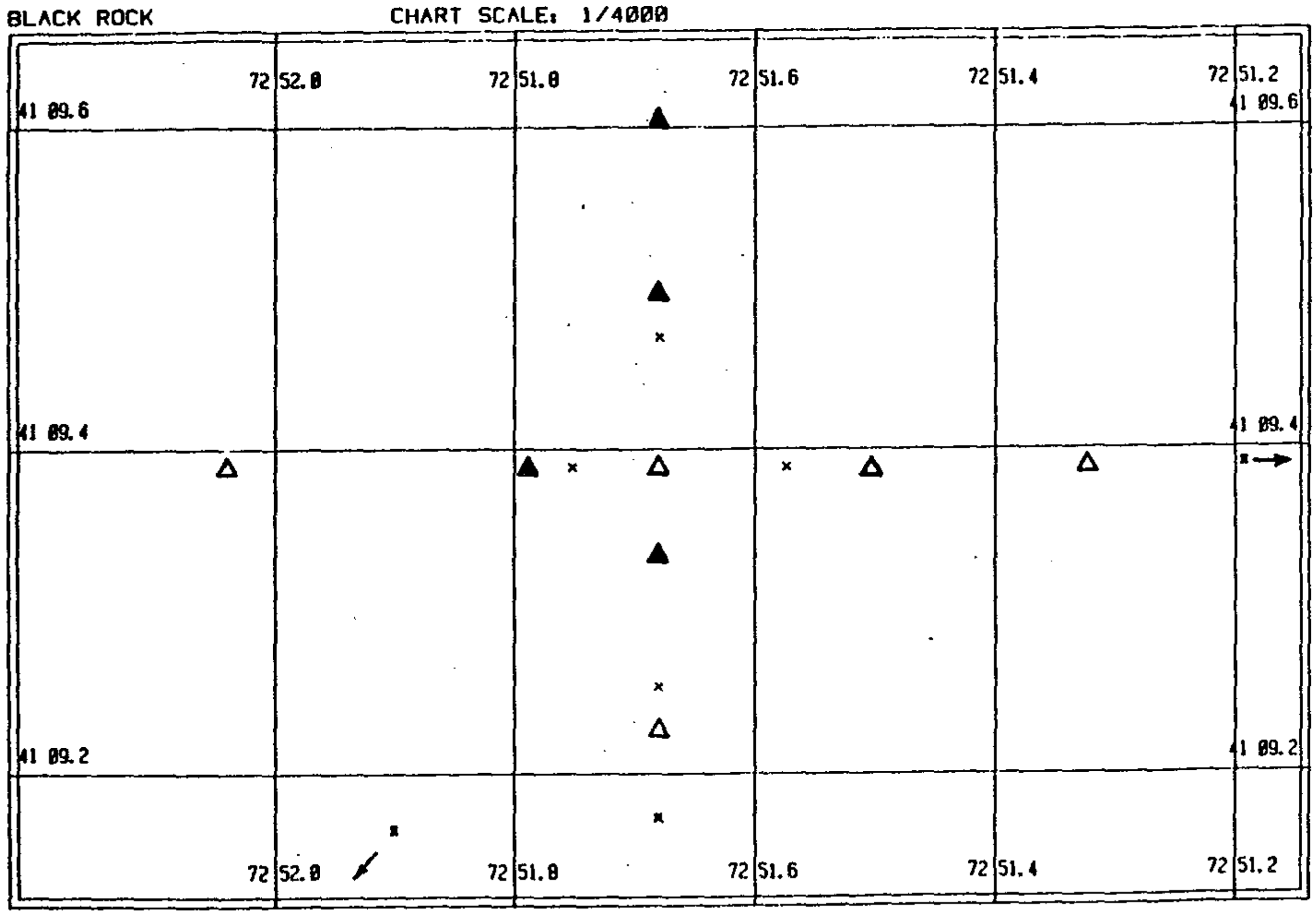


FIGURE III-3-22. Locations of station replicates which show evidence of surficial erosion. The solid triangles are stations where actual erosion is visible in the photo, or where ripples or shell lag are present. The open triangles represent stations where mud clasts were present at the surface, indicating erosive activity in a nearby area.

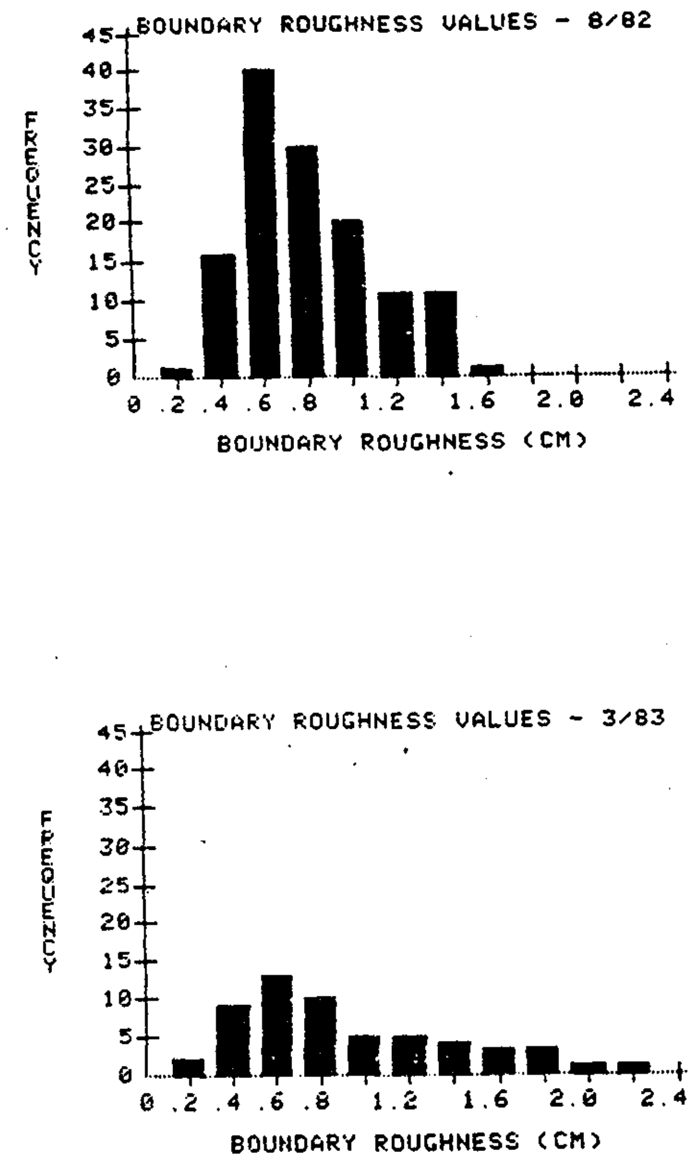


FIGURE III-3-23. Comparison of histograms for boundary roughness, predisposal conditions August, 1982 and March 1983 (for August n = 135; March n = 57). The length scale of the measurements is limited to 12.75 cm (width of the Remots™ window). The values represent the maximum vertical relief of the sediment surface. Class intervals were constructed by placing all values from 0.00 to 0.20 at 0.20, all values from 0.21 to 0.40, etc.

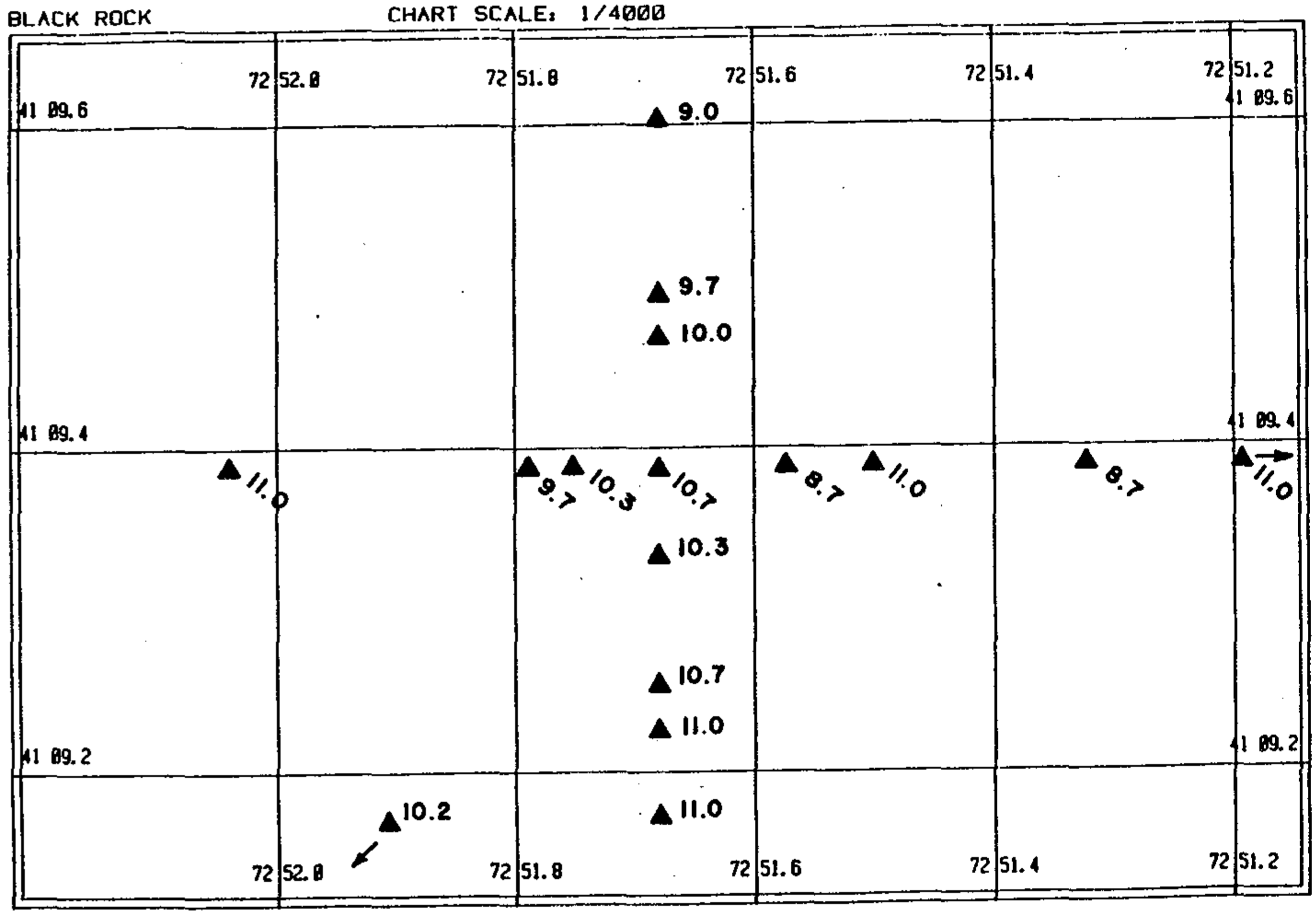


FIGURE III-3-24. Habitat indices plotted at the sampling locations. These values represent a mean of three replicates, except for CLIS-REF site, where n = 12. As in August, 1982 most of the seafloor stations have values greater than 9.0; which represents a high habitat quality.

and microbial and meiofaunal activities (i.e. BOD) increase.

The student's t-test shows that the mean boundary roughness values are significantly different between August 1982 and March 1983 (using the 95% confidence interval to reject the null hypothesis). More station replicates in March 1983 (68%, n=15) showed evidence of surface erosion than in August 1982 (19%, n=52). Comparing only those stations in common to the two sampling periods (n=15), these percentages are 68% and 30% respectively. The areal increase in surficial erosion is probably related to the generally higher turbulence levels in near bottom water associated with winter storms.

The 1 cm deeper average penetration of the REMOTS camera prism in August 1982 compared to March 1983 may reflect the increased development of biogenic porosity (burrows, tubes, and feeding voids). March values are lower due to reduction of particle bioturbation activity because of low water temperatures (Rhoads and Boyer, 1982).

3.3.2 Distribution of Dredged Material

On 24 May 1983, a REMOTS survey was made at the 52 stations at the FVP site. These were the same stations occupied in the pre-disposal survey of the FVP area during 23-27 August 1982. The 24, 26 May survey was made about one week after the last barge loads of Black Rock harbor dredged material had been dumped at the FVP site.

On the initial 24 May reconnaisance survey, only one sample per station was taken. The thickness of dredged material was measured from the REMOTS negatives and a preliminary map was prepared. Based on this map, a second REMOTS survey was conducted on 26 May 1983 in order to define more accurately the limits of the dredged material. It was necessary in this second survey to add two new stations in order to find east-west areas unaffected by dredged material (1500E and 1000W). The twenty stations surveyed on 26 May are identified below along with the numbers of replicates taken at each station:

STATION	NUMBER OF REPLICATES
400N	2
300N	2
200N	2
150N	2
CTR	2
100S	2
250S	2
300S	2
400S	3
1500E	5
1000E	3
500E	2

400E	2
250E	2
150E	3
100W	2
150W	2
250W	2
500W	2
1000W	4

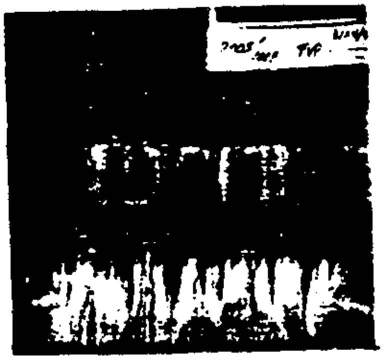
Because all of these stations (except 1500E and 1000W) had been surveyed earlier on 24 May, a minimum of three station replicates were available to construct the final dredged material thickness map. Stations located in the NE, SE, SW and NW quadrants of the FVP survey grid are represented by only one photograph each taken on 24 May 1983. The detection and measurement of dredged material from REMOTS images was accomplished with the Measuronics LMS Image Analysis System (Fig. III-3-25). The presence of dredged material was easily detected because the black reducing dredged material was located above a light-colored ferric hydroxide zone. This ferric hydroxide zone represents the aerobic surface of the normal bottom prior to dumping. This mapping technique requires that the survey be made soon after disposal terminates before the buried ferric hydroxide interface becomes reduced, erasing the redox "stratigraphy".

Figure III-3-26 is an isopleth map of the Black Rock Harbor material at the FVP site. Thickness is contoured on 2 cm intervals. Because the REMOTS camera prism penetration is limited to 20 cm, thicknesses greater than this window depth cannot be accurately measured. For this reason, the depositional center of the mound (the area enclosed within the 12cm isopleth) is designated as being greater than or equal to 15 cm thick. Within this central area, the camera prism completely penetrated through the dredged material layer at stations 100W, 150E, 100S, and 200N and show it to be 16 cm, 11 cm, 12 cm, and 8 cm thick, respectively. Station replicates at CTR, 100E, 100N, and 150N did not completely penetrate the deposit and, therefore, the minimum thicknesses are given at these stations. Based on the isopleth data, the area of dredged material located within thickness contours is given in Table III-3-2. All the Black Rock Harbor material appears to be contained within an area of $1.2 \times 10^6 m^2$ which has an outside perimeter of 7,441 meters (zero isopleth).

On 13 June 1983 another REMOTS survey was conducted where 11 stations were added to the east-west transect that was sampled on 26 May. A complete station list is given in Table III-3-3.

Based on this survey, a new map was constructed (Fig. III-3-27) which shows an area of $7.36 \times 10^5 m^2$ affected by disposal of dredged sediments. The major uncertainty in this map is the position of the boundary on the west side of the FVP site. This area is shown in a cross-hatched pattern in Figure III-3-27 and occupies an area of $1.49 \times 10^5 m^2$. Dredged material in

A



B

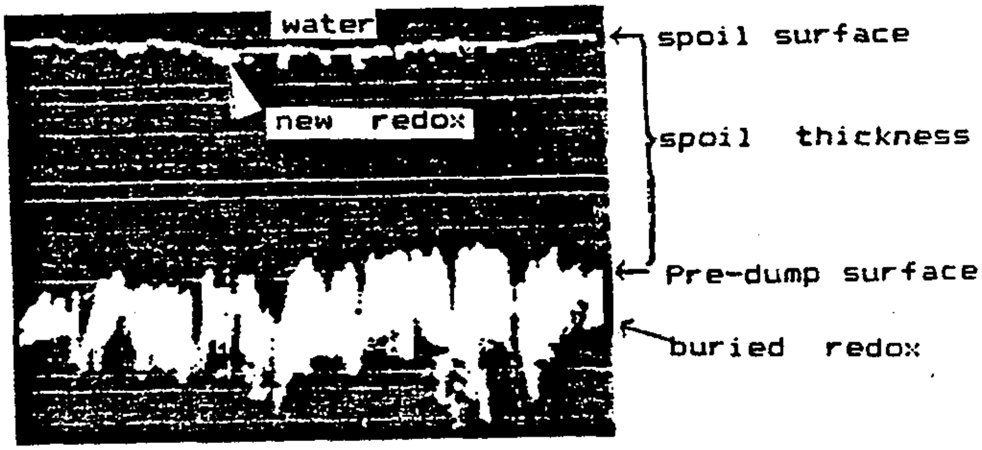


FIGURE III-3-25. Method of measuring spoil thickness from Remots images. A) Remots[tm] photograph of station 200S-100E. B) Digitized image of (A) showing spoil thickness above a buried redox (pre-dumping surface), and newly developing redox at the spoil-water interface.

BLACK ROCK FVP

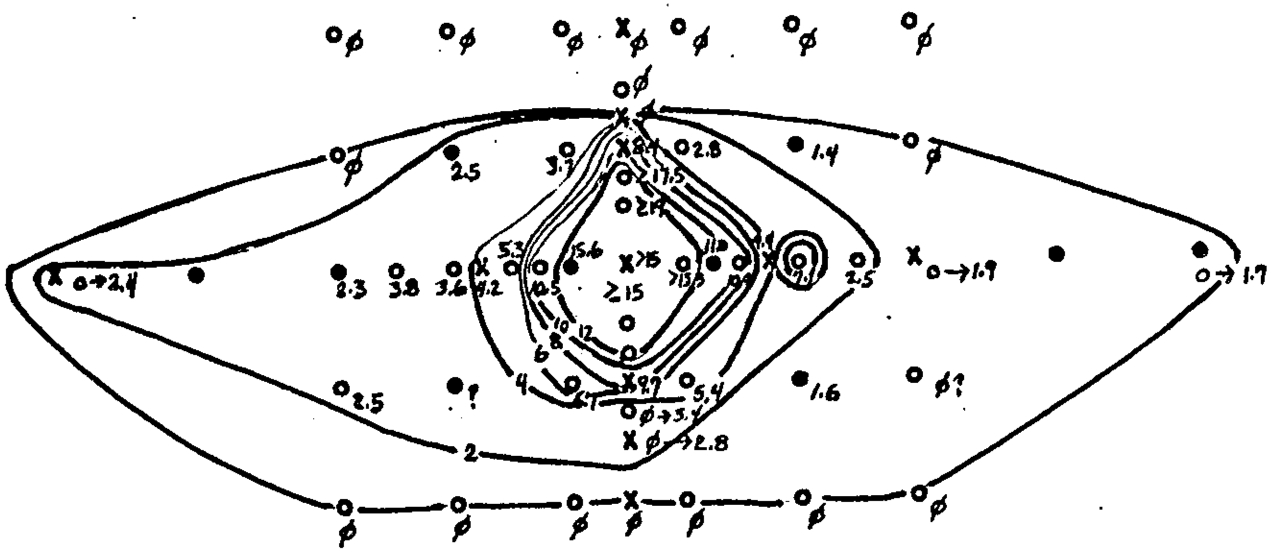


FIGURE III-3-26. Isopleth map of dredged material thickness at the FVP site. Contour interval is 2 cm. Values by station mmarks are mean thicknesses in cm. Data from REMOTS^{tm} survey done on May 24 and 26, 1983, about one week after termination of dumping.

TABLE III-3-2

The Area of Dredged Material
Contained Within Discrete Isopleths

Spoil Thickness Intervals (cm)	Area (M^2)
0-2	699,121
2-4	321,722
4-6	58,255
6-8	25,688
8-10	17,011
10-12	26,825
$\geq$15	52,410

Sum = 1.2×10^6 M^2

TABLE III-3-3

FVP and CLIS-REF Stations Occupied On
June 13, 1983 with Number of Replicates Per Station

Station	Rep.	Station	Rep.
400N	3	1500W	3
250N	3	1400W	2
200N	3	1300W	2
CTR	3	1200W	2
200S	3	1100W	3
300S	3	1000W	3
400S	3	750W	3
1500E	3	500W	3
1400E	2	250W	3
1300E	2	100W	3
1200E	2	200N/300W	2
1100E	2	200S/300W	3
1000E	3	200N/300E	2
750E	3	200S/300E	2
500E	3	CLIS-REF	3
300E	2		
250E	3		
150E	3	N = 33	n = 87

SAIC

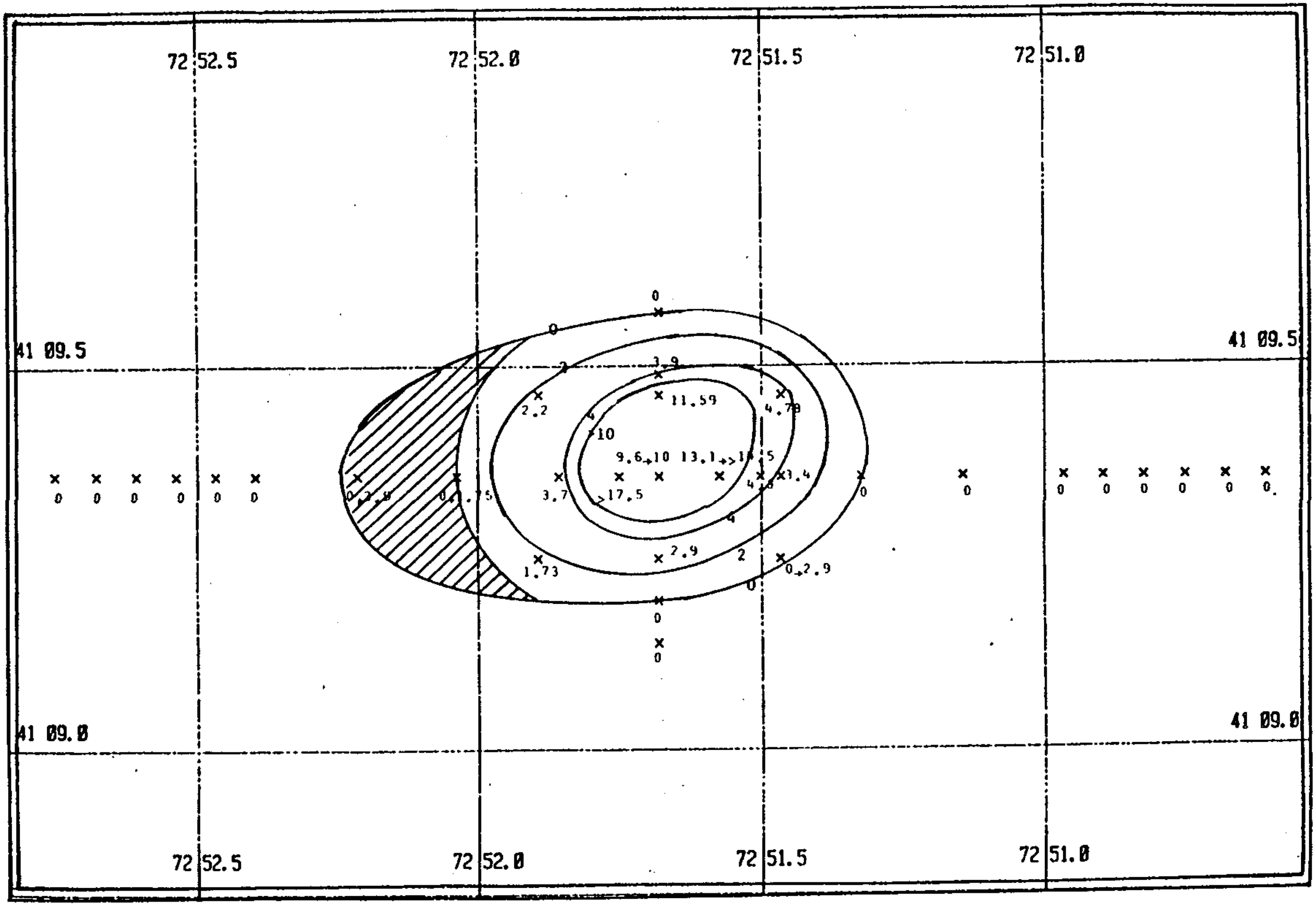


FIGURE III-3-27. Revised Dredged Material Isopleth Map.

this area is patchily distributed with some station replicates showing the presence of dumped material while other replicates show a "normal" bottom. Table III-3-4 gives the area of dredged material contained within discrete isopleths. The outside perimeter of the zero isopleth is 3297 meters in circumference.

3.3.3 Immediate Post-Disposal Surveys

REMOTS surveys were conducted at the FVP site during the post-disposal phase on 13 June, 19 July and 29 August 1983. In June, the following 33 stations were sampled:

Station	Replicates	Station	Replicates
400N	3	1500W	3
250N	3	1400W	2
200N	3	1300W	2
CTR	3	1200W	2
200S	3	1100W	2
300S	3	1000W	3
400S	3	750W	3
1500E	3	500W	3
1400E	2	250W	3
1300E	2	100W	3
1200E	2	200N/300W	2
1100E	2	200S/300W	3
1000E	3	200N/300E	2
750E	3	200S/300E	2
500E	3	CLIS-REF	3
300E	2		
250E	3		n = 87
150E	3		

In July and August, the station number was reduced to the following 21 stations:

400N	1000E	750W
250N	500E	1000W
200N	250E	200N/300E
CTR	150E	200N/300W
200S	100W	200S/300E
300S	250W	200S/300W
400S	500W	CLIS-REF

Three replicate photograrphs were taken at each FVP station while at least 5 were taken from the CLIS REF site.

3.3.3.1 Sediment Texture

The dominant or major modal grain size at the FVP site

TABLE III-3-4

Area of Dredged Material Contained Within Discrete Isopleths

Thickness Interval (cm)	Area (M^2)
0-2	365,046
2-4	185,177
4-10	71,981
10	113,096

Total = 7.36×10^5 M^2

SAIC

is 4ϕ , silt-clay. In June, the surface of the dredged material contained very fine (4-3ϕ) to fine sand (3-2 ϕ) at 200N, 250N, 100W, 250W, 250E, 150E and 200N/300E. These conditions remained essentially unchanged in the next two surveys. Figure III-3-28 shows the frequency distribution for small-scale relief at the sediment-water interface. The major mode for boundary roughness values is 0.8 cm; the majority of roughness elements at the sediment surface are microtopographic, related to biogenic sediment reworking.

3.3.3.2 Redox Potential Discontinuity (RPD) Depth

Figure III-3-29 shows the mean RPD depth in June. The area of deposit where RPD depths are 3.74 cm is outlined in the figure. The area within this boundary contains an abnormally thin redox layer characteristic of newly disturbed bottoms. The critical value of 3.74 cm is based on the 13 June 1983 data for the CLIS-REF station which had a mean value of 3.74 cm. The surveys of the FVP site in August 1982 and March 1983 showed that the ambient seafloor has RPD depths 3.0 cm with the major mode being ca. 4 cm.

If the RPD values map of Figure III-3-29 is compared to the isopleth map (Fig. III-3-26), the 3.74 cm deep RPD boundary contour can be seen to be coincident with the zero dredged material isopleth. The area equals 7.36×10^5 m^2. Although redox depths are, in this case, dependent on the presence or absence of dredged material, their measurement from REMOTS images is independently made and, therefore, these two parameters are used as separate criteria for the identification of disturbed seafloor at the FVP site.

In July, 15 stations showed a redox depth less than the CLIS-REF station ($\bar{X}$ = 3.58 cm, N = 5). This distribution is similar to that found in June, with three exceptions: Stations 250N, 500E, and 200S/300E (Fig. III-3-30). Station 250N had a very thin redox ($\bar{x}$ = 0.85 cm) on 6 June 1983, while the redox depth on 19 July ($\bar{x}$ = 4.28 cm) appeared to be greater than the CLIS-REF station ($\bar{x}$ = 3.58). Two possibilities are offered to explain this difference. No "double" redox was observed at 250N on 19 July. This may mean that the particular area surveyed in July was just off the edge of the pile, or, alternatively, that the pumping activities of the colonizing polychaetes had depressed the surface redox downward until it merged with the underlying (previously buried redox).

The second exception is Station 200S/300E which had a deep redox ($\bar{x}$ = 4.,77 cm) in June. This survey shows an anomalously shallow ($\bar{x}$ = 2.80 cm) redox depth. This change in redox depth is believed to be real and the data suggest that this station is experiencing a retrograde succession.

The third exception is station 500E, which lies off the east side of the mound. In June, this station had a mean RPD depth of 5.84 cm. This redox has rebounded to a depth of 2.80 cm. The status of the successional stage at this station is questionable, and this area might also be in a retrograde condition.

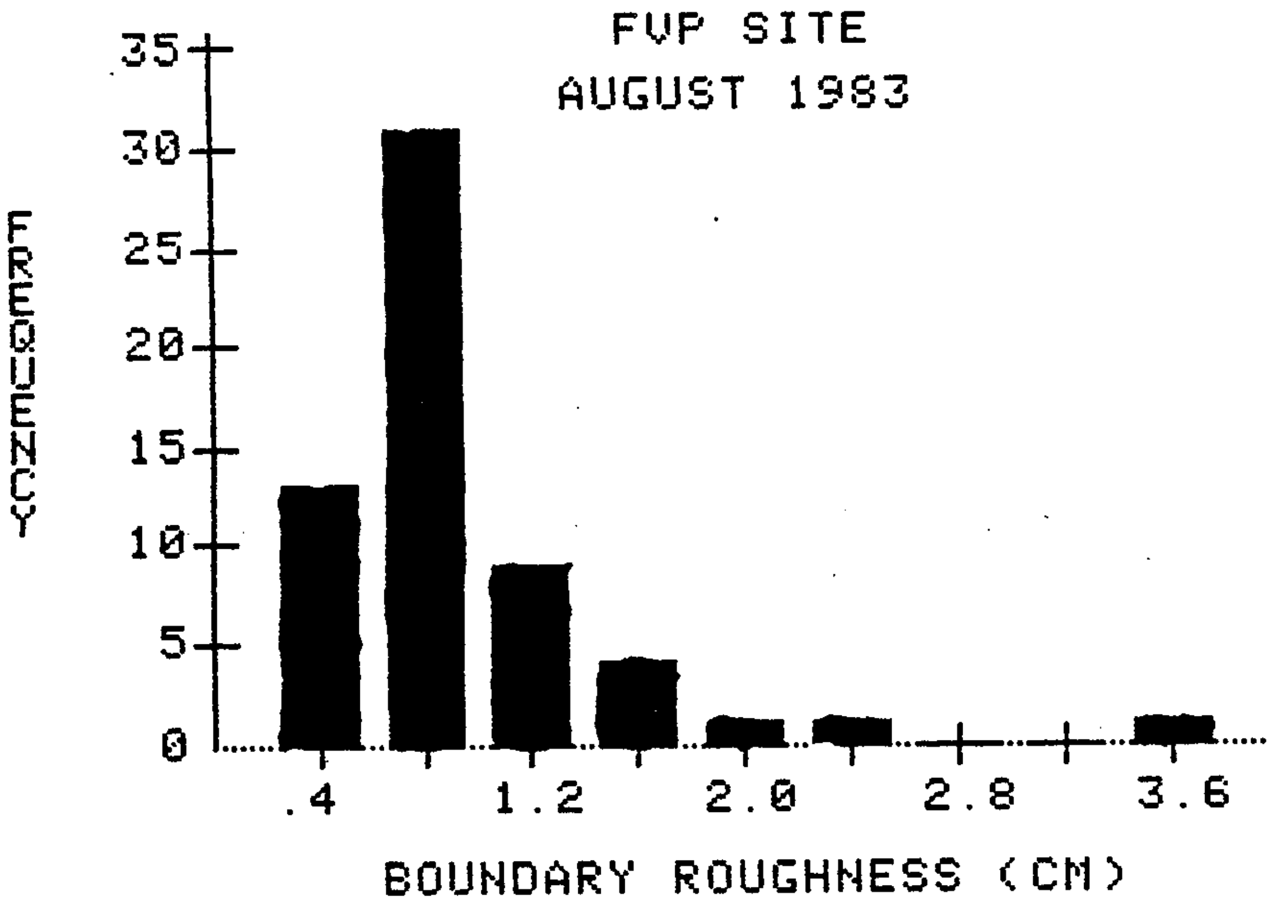


FIGURE III-3-28. Frequency distribution for boundary roughness values at the sediment-water interface.

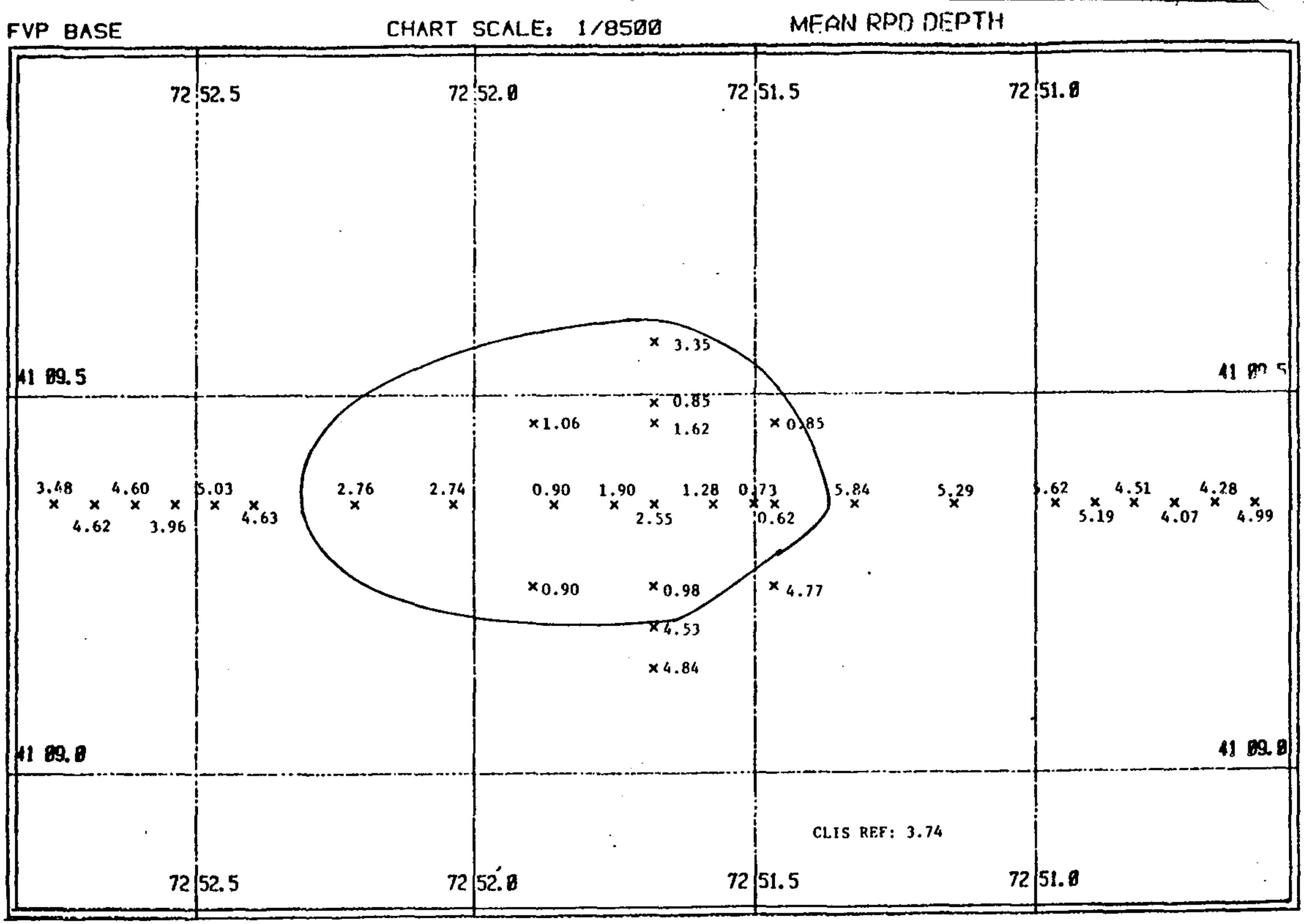


FIGURE III-3-29. Depth of the Redox Potential Discontinuity (RPD); values at each station in centimeters. Areas enclosed in outline are those stations where RPD depth is less than the value at the CLIS-REF station (3.74).

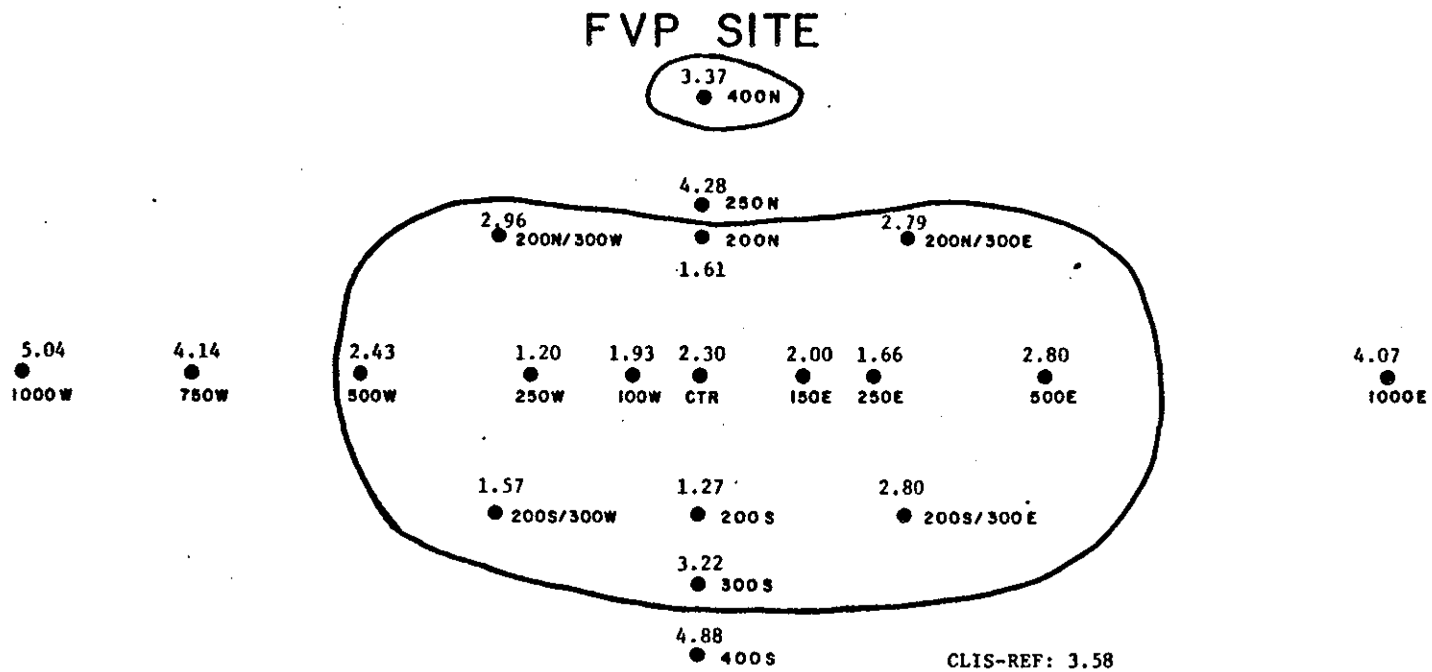


FIGURE III-3-30. Depth of the Redox Potential Discontinuity (RPD); values at each station in centimeters and are the mean of three replicates. Areas enclosed in outline are those stations where RPD depth is less than the value at the CLIS-REF station (3.58).

Figure III-3-31 shows the average depth of the RPD in August. Areas where RPD depths are less than the CLIS-REF stations ($\bar{x}$ = 3.99 cm, N = 6) are enclosed within an outline in the figure. Only 13 stations are included within this "anomalously" thin redox region, as compared to 15 in July.

Figure III-3-32 shows a bimodal frequency distribution of RPD depths at the FVP site. The major mode for stations affected by dredged material is the 3 cm class interval; the major mode for stations from the ambient seafloor and CLIS-REF station is 4.5 cm. The mean redox depth in June in the BRH deposit was 1.63 cm (N = 15) while that of the ambient seafloor was 4.62 cm (N = 16). In July, the RPD depth on the site increased to 2.29 cm (N = 14) while the mean RPD depth on the ambient seafloor was 4.05 (N = 6); the values for BRH-affected and ambient stations in August are 2.90 cm (N = 14) and 4.67 cm (N = 6), respectively. The depth of the RPD has increased approximately 0.6 cm/month since June.

3.3.3.3 Successional Stage

The macrofaunal colonization of dredged material was observed, but not reported, in May surveys made about one week after termination of the disposal project. This colonization continues and the successional map is shown in Figure III-3-33. Fourteen stations located within the disposal area contain only Stage I (polychaete dominated) infauna or are azoic. Those stations designated I -- 0 contain only small (1-2 cm) diameter patches of polychaete tubes (Stage I) which are spatially separated by barren sediment (Stage 0).

The method of colonization has apparently taken place by both upward escape of buried polychaetes and by larval recruitment. The size distribution of tubes indicates that these two mechanisms have taken place. Some tubes are already large (reestablished adults) while other populations consist of very small tubes (new recruits). Some images show vertical burrows cutting across the dredged material and have their origins in the underlying pre-disposal sediment. These structures may represent vertical "escape" burrows.

Stage I conditions also apparently exist outside of the zero dredged material isopleth area but most stations surrounding that area also show evidence of Stage III taxa (subsurface feeding voids).

In July, the overall successional status of the FVP site (Fig. III-3-34) remains unchanged from the last survey. All stations within the disposal area are in a Stage I or I -- 0 condition. Stations 150E and 250E are the only stations where Stage I polychaetes have not successfully colonized the bottom. These stations are represented by small patches of polychaetes separated by barren sediment. This explains the very irregular and shallow depths of the RPD at these stations (150E = 2.00 cm;

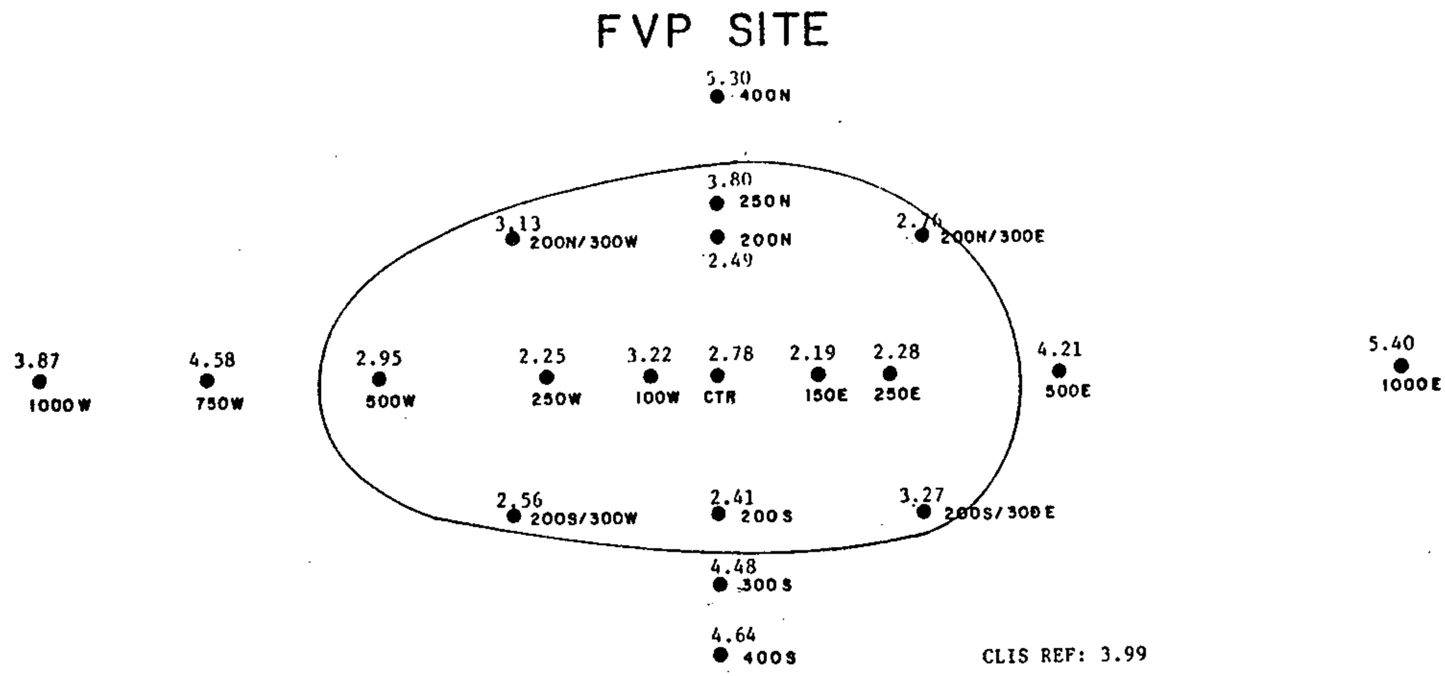


FIGURE III-3-31. Depth of the Redox Potential Discontinuity (RPD); values at each station (in centimeters) are the mean of three replicates. Area enclosed in the outline are those stations where the RPD depth is less than the value at the CLIS-REF station (3.99 cm).

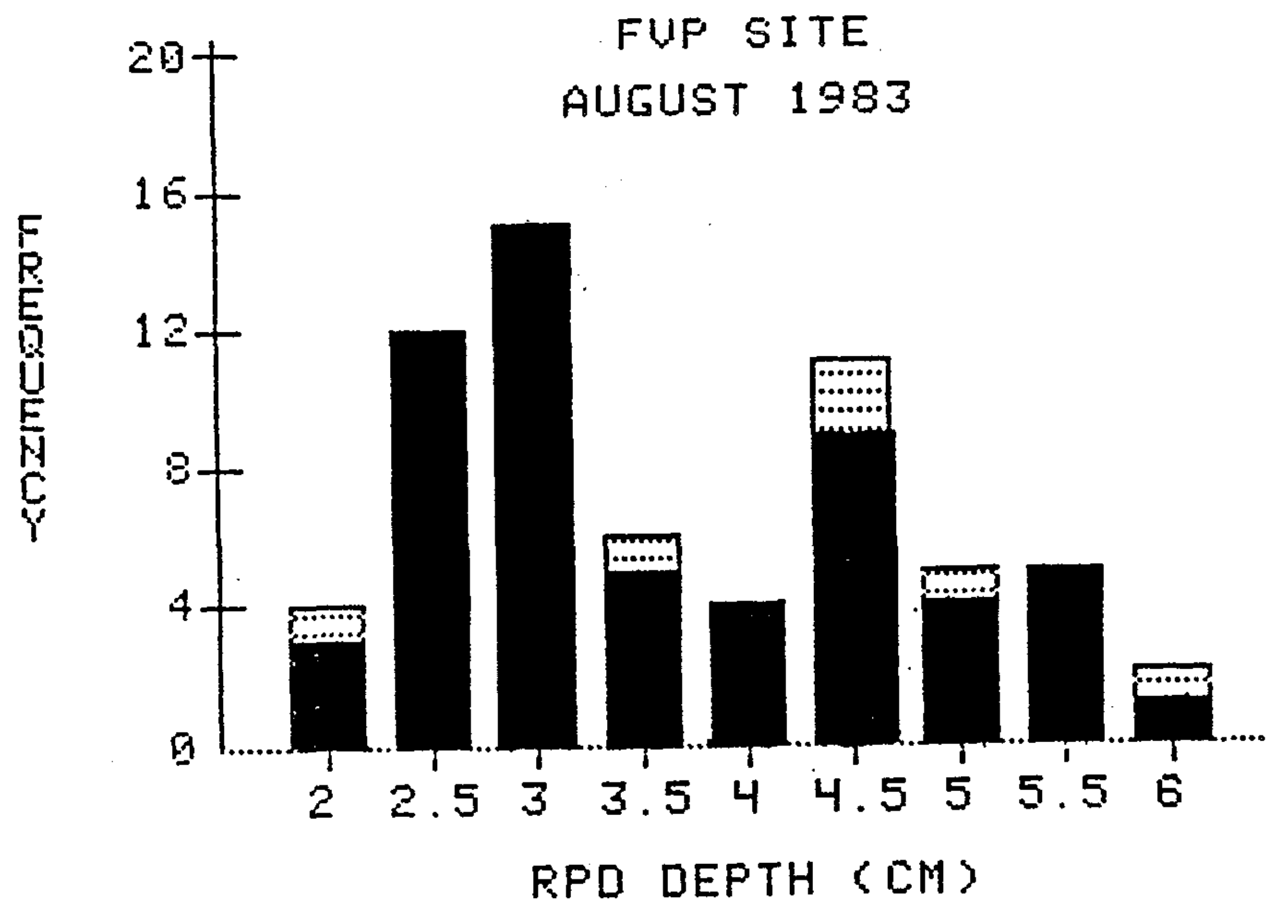


FIGURE III-3-32. Frequency distribution of mean RPD depth at the FVP site; stippled bars are values from the CLIS-REF station.

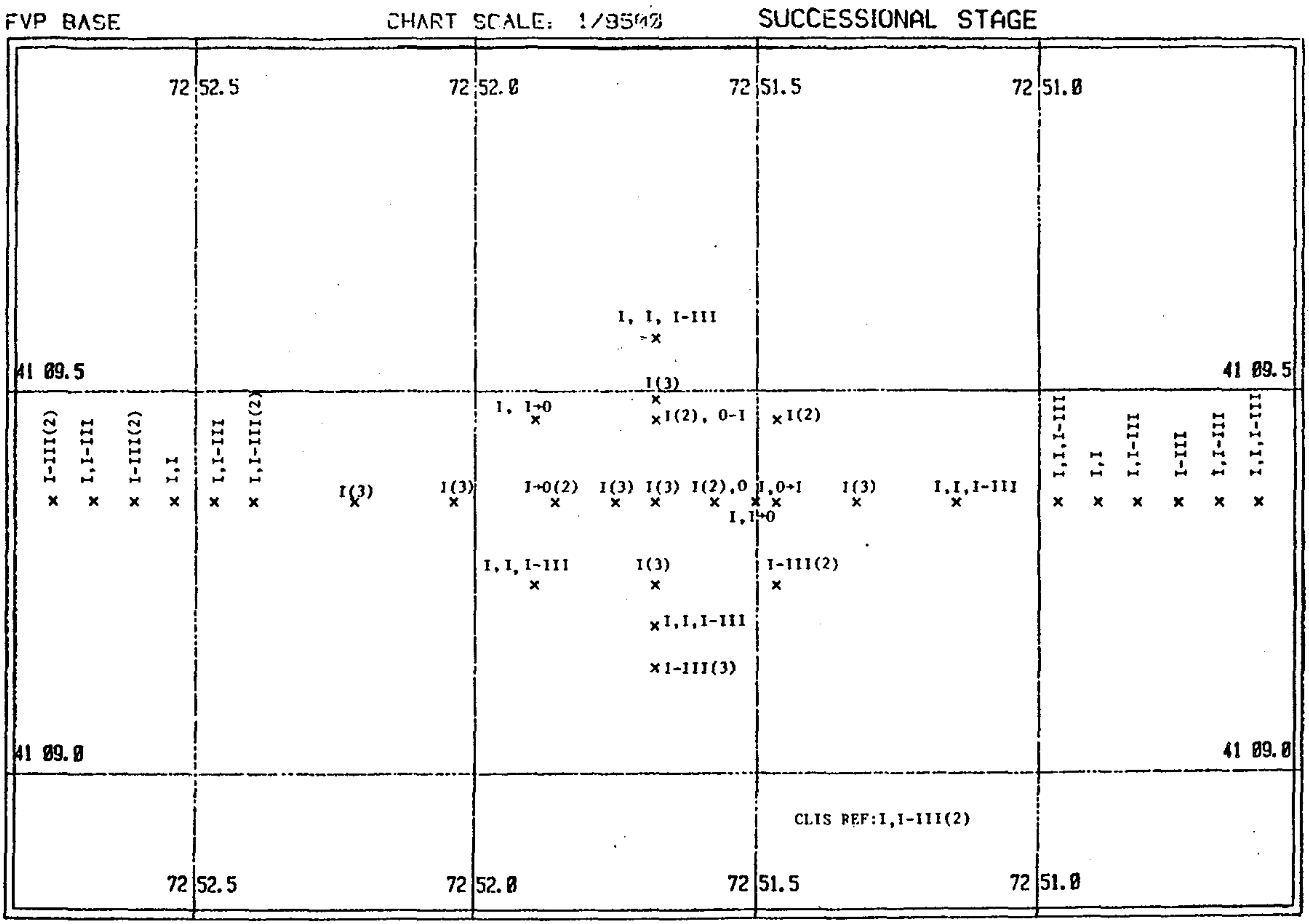


FIGURE III-3-33. Successional stage values at FVP stations, May 1983. Numbers in parentheses indicate number of replicate images for that particular value.

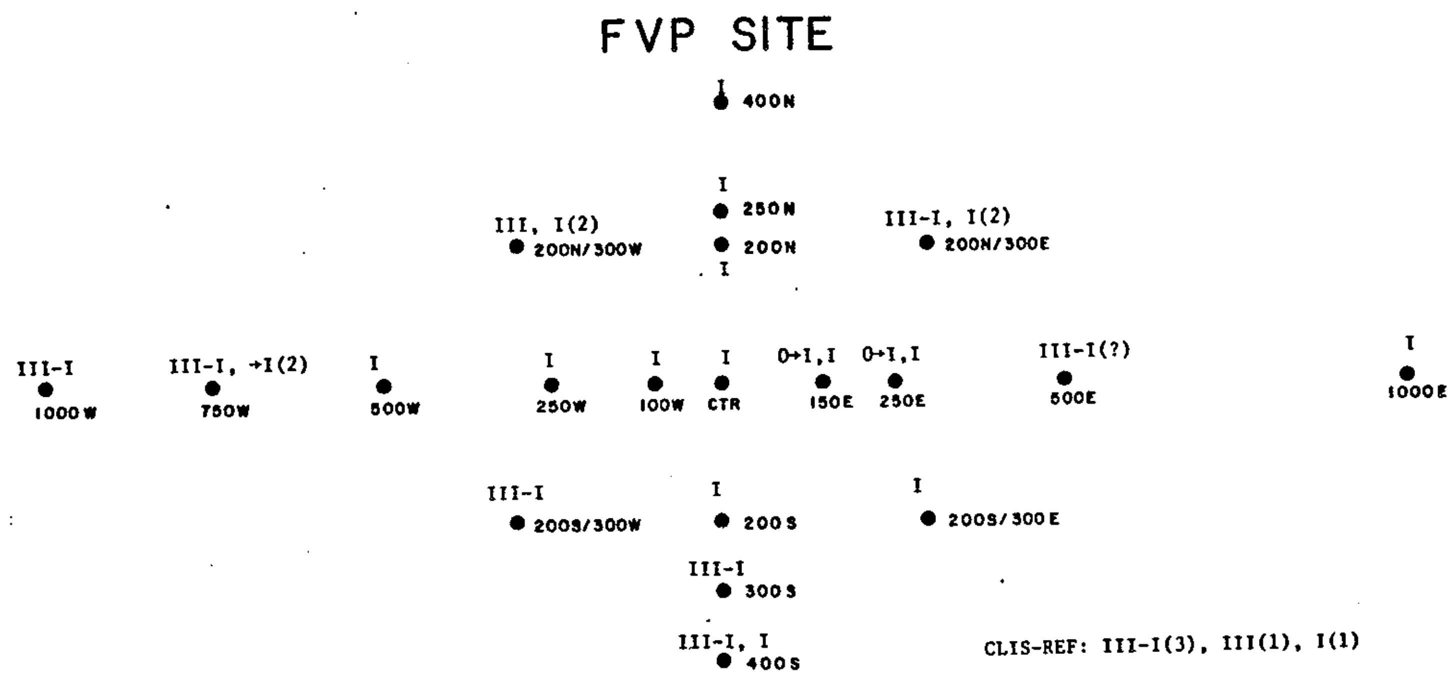


FIGURE III-3-34. Successional stage values at FVP stations, July 1983. Numbers in parentheses indicate number of replicate images for that particular value.

250E = 1.66 cm). Stations 200S/300E and 400N have been retrograded from a Stage I-III (13 June 1983) to a Stage I. One of the replicate images at 400N shows evidence of surface erosion in the form of mud clasts and an eroded redox.

By August, the overall successional status of the FVP site (Fig. III-3-35) had improved with several stations within the dredged material area having been colonized by bioturbating deposit-feeders. These stations are indicated by a I-III status on the map (250N, 200N/300E, 500W, 250W, 250E, 200S/300E). Stations 150E and 250E were previously noted as being the only stations where Stage 1 polychaetes had not successfully colonized the bottom. These stations are now colonized by Stage I polychaetes (one replicate at 250E shows a quite mature successional sere present), but the values for mean RPD depth at these stations are still the lowest for the entire site (Fig. III-3-35). One possible explanation for the shallow redox values at these stations and some of the others found in previous surveys is the activities of commercial draggers in the area. Information obtained by Dr. Frank Bohlen indicates that commercial draggers are frequently working the area between the center of the mound and 400E. While there is no photographic evidence of strong physical scour at the sediment surface at any of these stations, it is possible that the retrograde successional features noted previously and continued shallow redox values at 150E and 250E could be due to the disturbance caused by otter trawls. Strong bottom currents could quickly fill in and erase any evidence of irregular furrows and depressions caused by the fishing gear. Alternatively, these stations may have experienced slower colonization because of biologically inhibiting compounds contained within the BRH dredged material.

3.3.3.4 Habitat Index

The indices reflect both faunal successional stage and redox depth. The distribution of these indices in June is shown in the map of Figure III-3-36. All stations located within the disposal area have indices less than 8 and most stations fall below an index of 5. The modal index is 2. Baseline studies in August 1982 and March 1983 showed the area of the FVP site to have habitat indices ranging from 10-11. The frequency distribution of habitat indices for post-disposal conditions are comparable to the distribution found for DAMOS dump sites in Long Island Sound.

Stations located outside of the disposal area have values 5 and the distribution is bimodal with peaks at 7 and 11. This bimodal distribution mainly reflects whether or not a station replicate contained evidence of only Stage I (lower value) or also displayed subsurface feeding voids characteristic of stage III infauna (higher value).

Figure 3-37 shows the distribution of habitat indices in July along with those 20 cm bathymetric contours which define the apparent area of BRH disposal. All stations with habitat

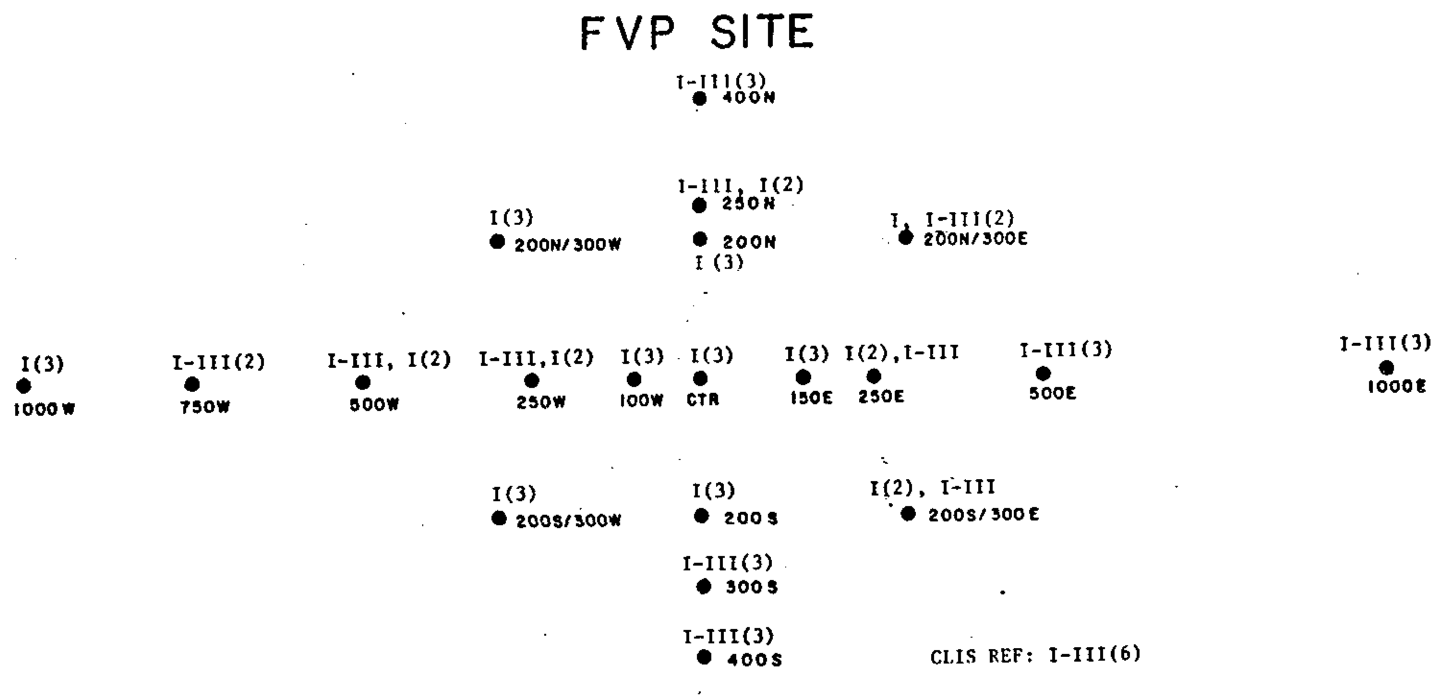


FIGURE III-3-35. Successional stage values at FVP stations, August 1983. Numbers in parentheses indicate the number of replicate images for that particular value.

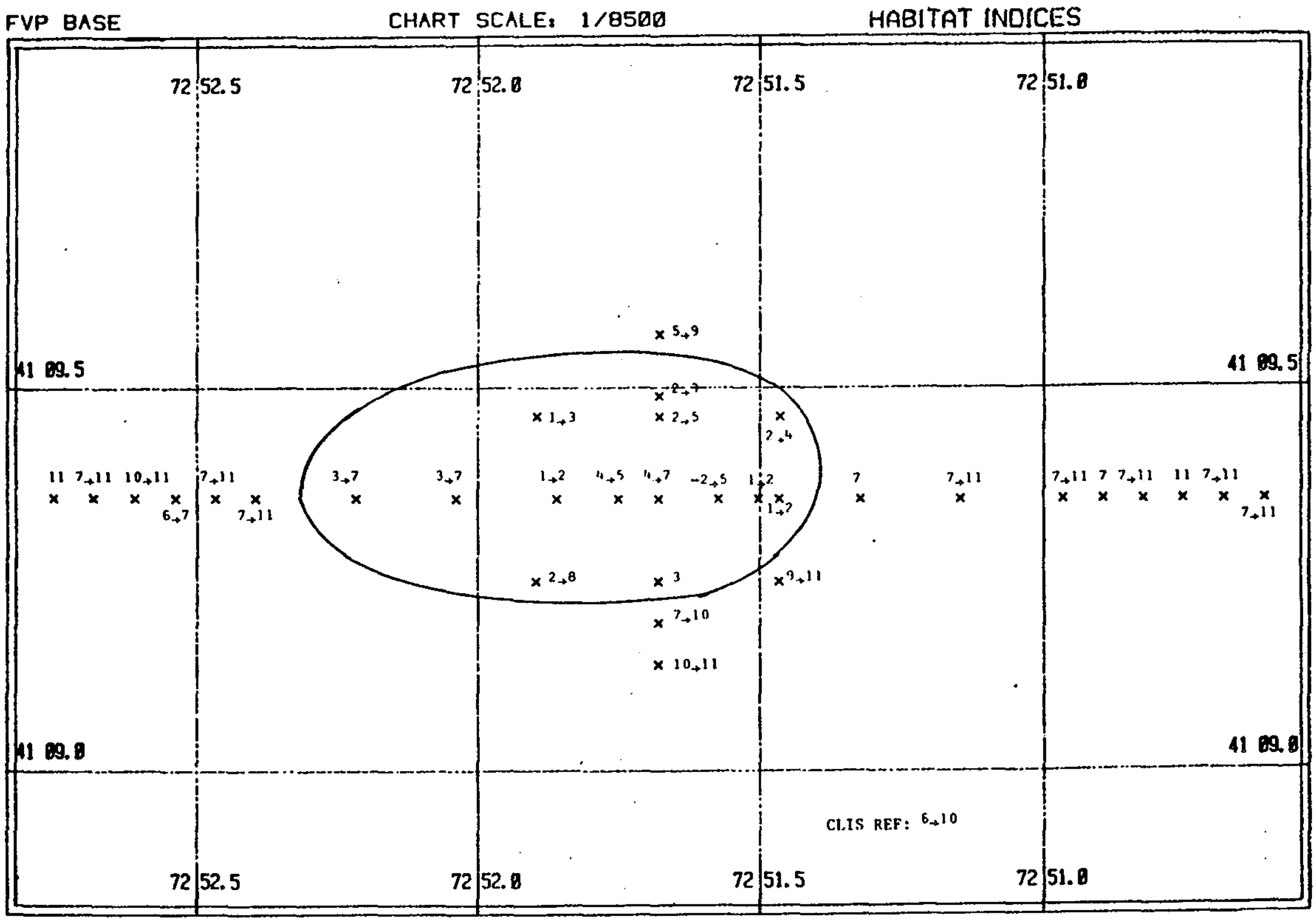


FIGURE III-3-36. Habitat index values at FVP stations, July 1983. Stations enclosed in outline are those where values are less than the CLIS-REF station.

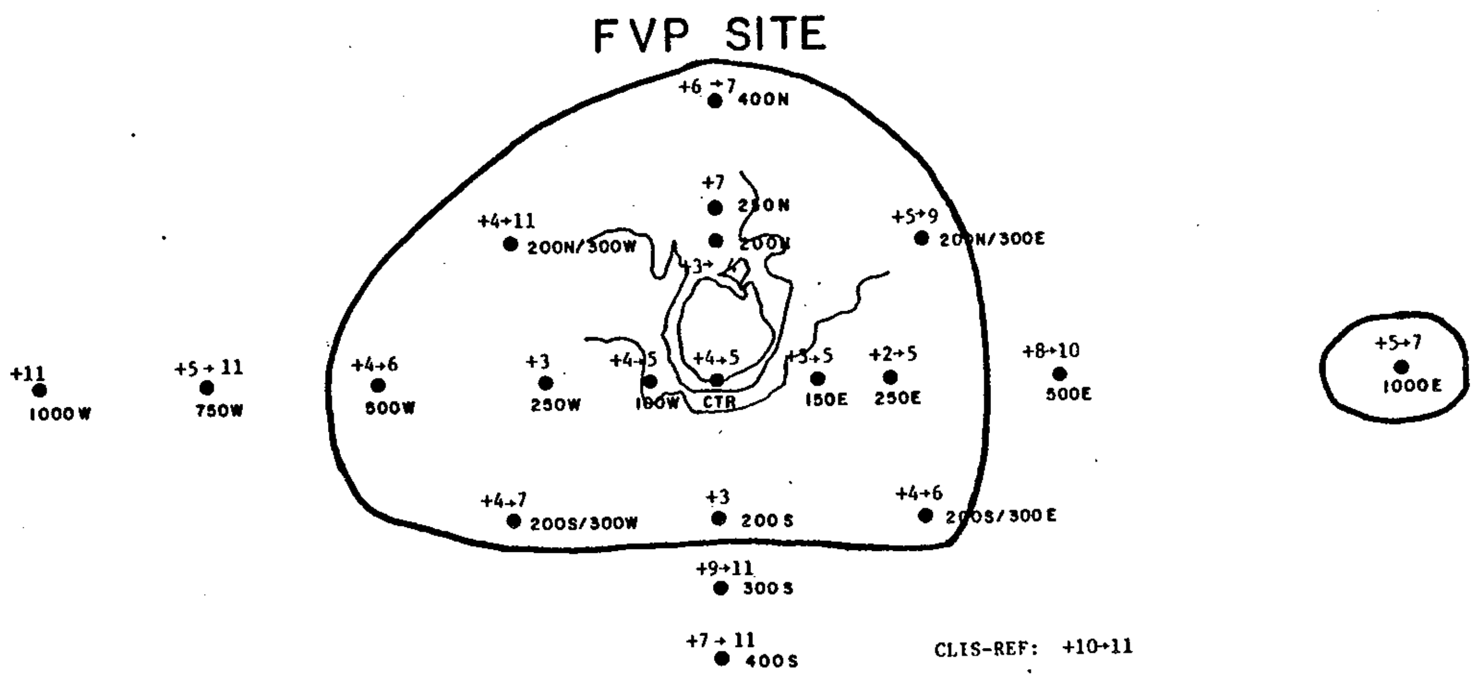


FIGURE III-3-37. Habitat index values at FVP stations, July 1983. Stations enclosed in outline are those where values are less than the CLIS-REF station.

values less than the CLIS-REF station (index value equal to or greater than +10) are enclosed by lines. Interestingly, this area of depressed habitat values differs from the June survey by including stations 400N, 200S/300E, and 1000E.

The habitat index frequency distributions for stations located on the ambient seafloor and the CLIS-REF station are similar to those found in June, while the modal index for stations located in the FVP disposal area is higher in July (modal value = 4) than in June (modal value = 3). Because the successional stages did not change much over this time interval, the increase in habitat indices is related to an increase in the depth of the RPD in the colonized dredged material. The opportunistic polychaetes had progressively irrigated bottom sediments to a greater depth as they continue to colonize the surface and elongate their tubes downward into the dredged material.

The progressive improvement of the habitat index by August is illustrated in Figures III-3-38 and III-3-39. The modal habitat index within the disposal area had increased from +3 to +5, reflecting the progressive deepening of the RPD by infaunal polychaetes.

3.3.5 Summary

The grain-size distribution ($4\phi - 3\phi$) in the disposal area is unchanged over the immediate post-disposal period and was comparable to the ambient seafloor and CLIS-REF. Redox depths have increased on the average of 0.6 cm per month since June 1983 in the disposal area. The progressive depression of the RPD into the bottom was related to the irrigation activities of the initial colonizing tubicolous polychaetes and subsequent establishment of bioturbating deposit-feeders. The overall successional status of the disposal area showed improvement over the survey period. Some stations in the disposal area show a deep redox and evidence of head-down deposit-feeders. Stations 150E and 250E had a depauperate fauna, became colonized, but the redox at these stations remained comparatively shallow. These stations and others previously identified as experiencing retrograde succession could be experiencing disturbance due to commercial fishing activity. The modal habitat index on the disposal area has increased one class interval with each survey this summer. The modal value is now +5. This value largely reflects the progressive deepening of the RPD by infaunal deposit feeders.

3.4 Diver Observations

Pre-disposal diver surveys were conducted on 1 and 4 March 1983 and 18 April 1983. Four days after disposal another survey was made on 18 May, and then weekly dive surveys were conducted on 25 May, 3 June, 15-17 June and 22 June. Two more surveys were done on 15 July and 30-31 August 1983. Full descriptions of the dive conditions and types of observations are described in the DAMOS Dive Logs (Appendix III, Tables 3-1 to 3-20).

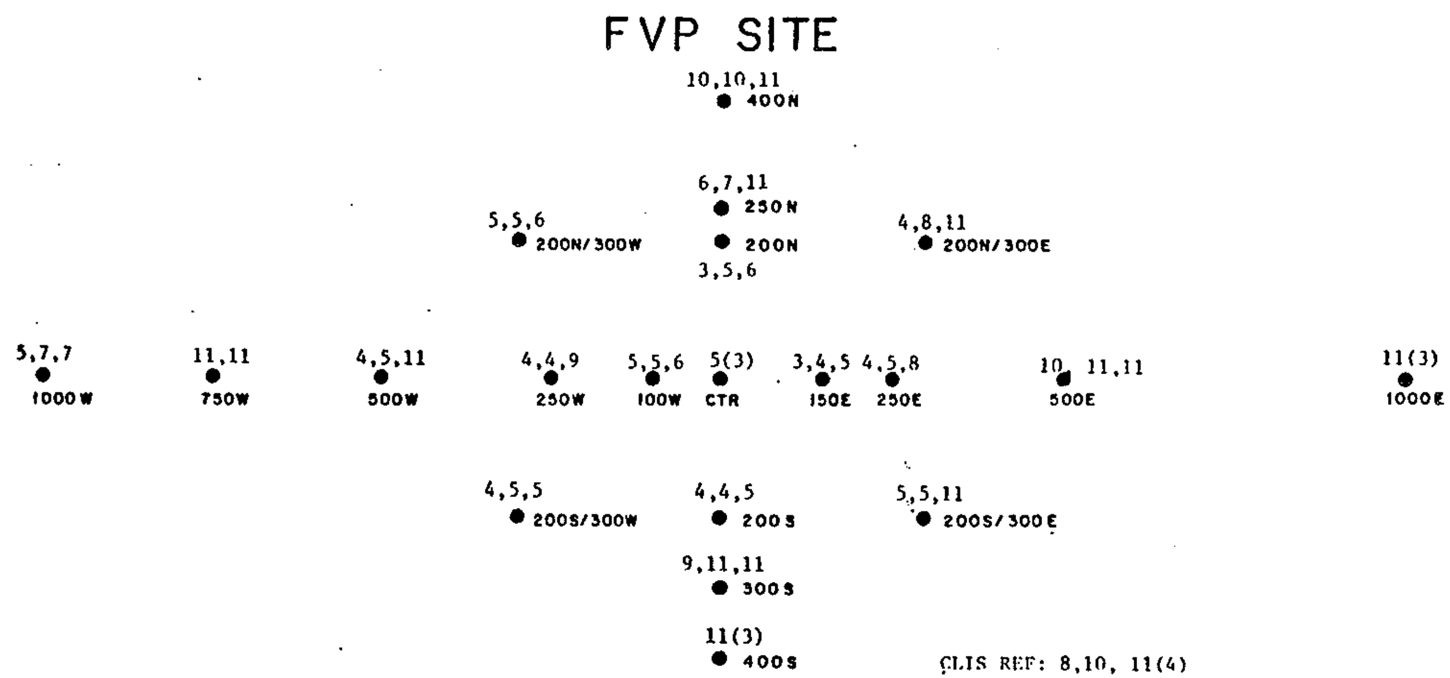


FIGURE III-3-38. Habitat index values at FVP stations, August 1983.

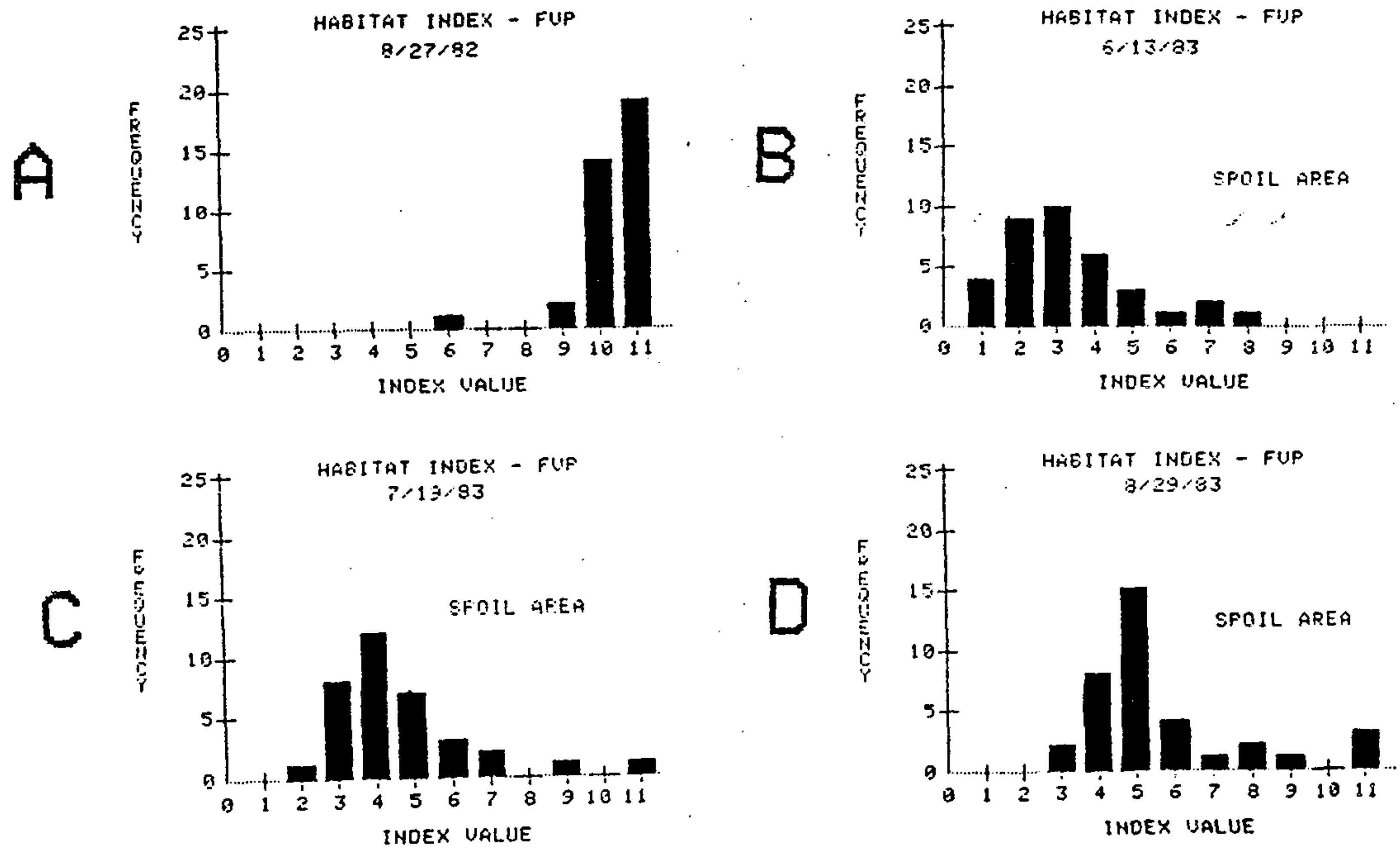


FIGURE III-3-39. Frequency distribution of habitat index values for stations covered by dredged spoil (N = 14).
A. August 1982 survey.
B. June 1983 survey.
C. July 1983 survey.
D. August 1983 survey.

3.4.1 Pre-Disposal Observations

The transect line for the early March surveys is shown in Figure III-3-40 and was conducted in an east-west direction over the center of the FVP site. The sediment surface was a consolidated clay/silt with a flocculent benthic veneer that was easily suspended by a moderate tidal current of 0.5 knots. The surface contained less than 1% visible shell fragments. Sediment topography was flat except for 10-15 cm diameter by 5-7 cm deep depressions created by feeding activity of Cancer irroratus. These depressions were encountered 2-3 meters along the transect. Accumulated sediment mounds, 1-2 cm high, were observed at the bases of the anemones Ceriantheopsis americanus. Other bioturbating species observed during the dives are summarized and presented in Table III-3-5, while Table III-3-6 summarizes the species and the quantitative abundance of the organisms collected in the two epibenthic samples. Photodocumentation of these baseline assessments is presented in Appendix III, Plates 3-1 to 3-14.

In the 18 April survey over the same transect, the sediment surface was typical of a natural bottom with decapod excavation every one or two meters. One Homarus americanus burrow and four smaller burrows, possibly constructed by Squilla empusa, were documented on this dive. Again, the predominant decapod bioturbation was feeding depressions created by Cancer irroratus.

A 30-second epibenthic sample was taken along the west leg of the transect line to quantitatively determine the local epifauna. It was noted during the sampling that the escape reaction exhibited by Crangon septemspinosa and mysids from the path of the epibenthic net must markedly affect the capture ratio of these organisms to less defensive species. Table III-3-7 summarizes the species and abundances of the epibenthic sample and Table III-3-8 summarizes the visual diver species count taken during this dive. Photodocumentation of these conditions are presented in Appendix III, Plates 3-15 through 3-18.

The two baseline surveys prior to the disposal of Black Rock Harbor dredged material showed the site to be rich in quantity and diversity of epifauna species.

3.4.2 Post-Disposal Surveys

On the immediate post-disposal survey on 18 May, two dives were made in 70 feet of water to observe sediment surface conditions and to survey and sample species types and abundances. The first dive transect sampled the immediate area around the position 250 m east from the center of the disposal site. The second dive was a westward transect from 500 m east toward the center of the site to determine the position of the dredged material periphery. The Loran-C coordinates for the eastern dredged material border on 18 May 1983 are 26533.1/43999.7.

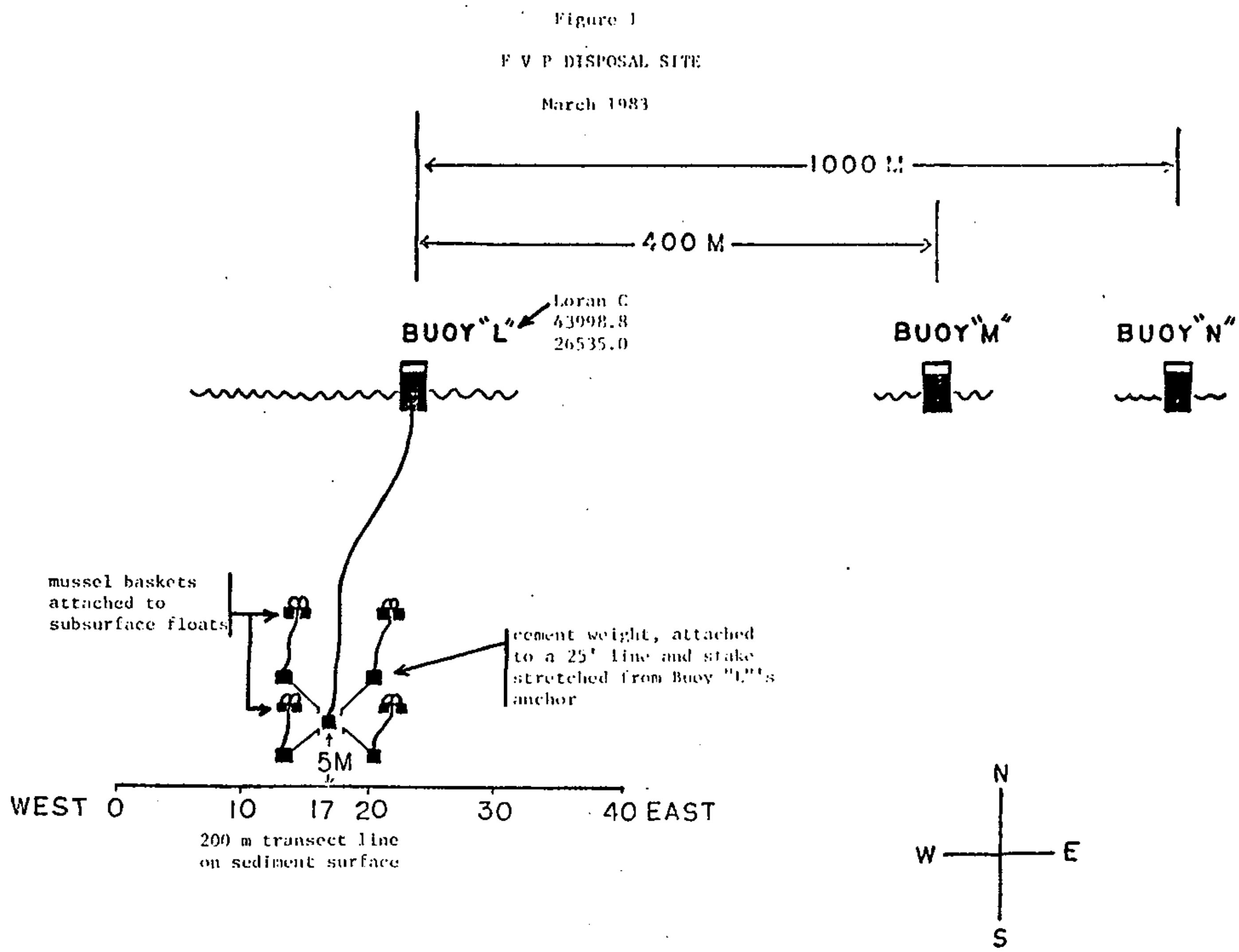


FIGURE III-3-40. Diver Survey Transect Line.

TABLE III-3-5

Diver Species Observations at Center of the FVP Dredge Disposal Site - Baseline Stage.

Species	Relative Abundance	
	1 March	4 March
Cnidaria		
Ceriantheopsis americanus	$13/m^2$	3
Corymorpha pendula	15	20
Gastropoda		
Nassarius trivittatus	20	10
Crustacea		
Cancer irroratus	15^+	37
Crangon septemspinosa (large)	3	--
Homarus americanus	1	--
Pagurus longicarpus	5	5
Copepod sp.	5	--
Pisces		
Pseudopleuronectes americanus (Juv., < 10 cm)	6	--
Scopthalmus aquosus	2	--
Echinodermata		
Asterias forbesi	7	8

TABLE III-3-6

Epibenthic Sample Summary, Center FVP Disposal Site - Baseline Stage

Species	Quantitative Abundance	
	1 March 83	4 March 83
Cnidaria		
Corymorpha pendula	--	6
Bivalvia		
Gemma gemma	240	136
Nucula proxima	10,240	11,220
Pandora gouldiana	200	340
Yoldia limatula	1,440	1,326
Gastropoda		
Lunatia heros	--	34
Nassarius trivittatus	12	16
Retusa cuniculata	360	170
Gastropoda sp.	40	--
Nudibranch sp.	--	1
Polychaeta		
Lepidontus squamatus	2	--
Nephtys incisa	10	10
Polychaeta sp.	--	4
Crustacea		
Cancer irroratus	1	2
Crangon septemspinosa	4	9
Neomysis americana	1	348
Pagurus longicarpus	--	2
Amphipoda sp.	5	1
Calanoid copepoda sp.	--	8
Cumacean sp.	13	16
Pisces		
Pseudopleuronectes americanus	1	--

TABLE III-3-7

Diver Visual Observations, 50 m West of Center, FVP Dredge Disposal Site - Baseline Stage.

Species	18 April 1983 Relative Abundance
Cnidaria	
Corymorpha pendula	$19/m^2$
Gastropoda	
Nassarius trivittatus	100^+
Crustacea	
Cancer irroratus	4 (adult) 20^+ (juv.)
Crangon septemspinosa	5
Homarus americanus	1
Libinia sp.	3
Pagurus longicarpus	15^+
Mysid sp.	300^+
Pisces	
Pseudopleuronectes americanus (10-15 cm)	10^+
Urophysis sp. (juv.)	2

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TABLE III-3-8

Epibenthic Sample Summary from a Diver Operated Hand Dredge 50 m West of Center, FVP Dredge Disposal Site - Baseline Stage.

Species	18 April 1983 Quantitative Abundance
Cnidaria	
Corymorpha pendula	24
Bivalvia	
Gemma gemma	4,152
Nucula proxima	17,820
Pandora gouldiana	96
Yoldia limatula	1,934
Gastropoda	
Lunatia heros	48
Nassarius trivittatus	31
Retusa caniculata	48
gastropoda sp.	180
Polychaeta	
Nephtys incisa	54
Crustacea	
Cancer irroratus	2
Crangon septemspinosa	9
Neomysis americana	12
Pagurus longicarpus	3
Amphipoda sp.	5
Cumacean sp.	1

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General sediment surface conditions on the dredged material material was characterized by soft black mud with a 1 mm brown surface veneer. Terrestrial plant leaves, wood debris and small (approx. 0.5 m) clay clumps littered the sediment surface and the extremely soft black material was only 15-20 cm thick at the 250E site. The sediment conditions at the 500E site were typical of a natural bottom in Long Island Sound, with light brown sediment and shallow, 5-7 cm, depressions left from *Cancer* sp. feeding activity.

Considerable biological activity by motile epifauna was observed both over dredged material and over the natural bottom. Bioturbation was evidenced as decapod tracks and fin prints on the newly deposited sediments and three *Cancer irroratus* were observed adjacent to a large boulder that had been transported with the Black Rock Harbor material. Only the sedentary hydroid *Corymorpha pendula* was notably absent from the BRH material covered areas. Table III-3-9 summarizes the species and their relative abundances observed on both dives. Diver collected epibenthic samples were taken both on and off the dredged material. Table III-3-10 summarizes the species and quantitative abundances from these two samples. It is interesting to note that, at this eastern border region, there were no apparent differences in the epifaunal communities between the two sites within four days following the dredged disposal period.

One week later, on 25 May, four dives were made in 68 feet of water to observe and photodocument sediment surface conditions and species types and abundances.

Sediment surface conditions were characteristic of recently deposited dredged material. Border regions were all transition zones of approximately 100 m where 2-3 cm of black dredged material tapered to a 1-3 mm veneer overlaying the light brown sediment of the natural bottom. No irregular topography was noted during each of the four border zone surveys. The black dredged material had a 2 mm oxidized surface layer.

Abundant bioturbation was observed along all the thin border regions in the form of fin prints from fish, decapod tracking and feeding excavation, bivalve venting and starfish activity. No *Corymorpha* were observed at any site. Evidence of starfish and crab feeding activity was observed by patchy areas of small shell fragments on the sediment surface or in shallow depressions. Table III-3-11 summarizes species observed and their relative abundance. Appendix III, Plates 3-19 through 3-28 photodocument the conditions observed at the northern perimeter of the dredged material.

Diver-operated epibenthic samples were obtained from the north and northeast dredge material borders. Quantitative species analysis proves that the border region is rich in sedentary epifauna, thus accounting for the abundance of motile and predatory epifauna visually observed during the dives. Table III-3-12 summarizes the species and abundances taken in the two

TABLE III-3-9

Diver Visual Species Observations FVP Dredge Disposal Site - Post Disposal Stage, 18 May 1983

Species	Relative Abundance	
	250 m E Site	500 m E Site
Cnidaria		
Cormorpha pendula	--	10
Crustacea		
Cancer irroratus	5	--
Pagurus longicarpus	5	--
Echinodermata		
Asterias forbesii	1	--
Pisces		
Pseudopleuronectes americanus	1	7
Scopthalmus aquosus	2	4
Urophysis sp.	--	1

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TABLE III-3-10

Summary of Diver Operated Epibenthic Samples, FVP Dredge Disposal Post Disposal Stage, 18 May 1983

Species	Quantitative Abundance	
	250 m E Site	500 m E Site
Gastropoda		
Nassarius trivittatus	18	14
Retusa canaliculata	520	870
Bivalvia		
Gemma gemma	1,368	750
Nucula proxima	7,826	15,810
Pandora gouldiana	26	90
Yoldia limatula	1,368	750
Polychaeta		
Nephtys incisa	47	27
Crustacea		
Cancer irroratus	1	1
Crangon septemspinosa	2	--
Neomysis americana	3	13

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TABLE III-3-11

Summary of Diver Visual Species Observations at Four Border Regions, FVP Dredge Disposal Site - Post Disposal Stage, 25 May 1983

Species	Relative Abundances N Border	NE Border	E Border	SE Border
Gastropoda				
Nassarius trivittatus	10	10	--	--
Bivalvia				
Yoldia limatula (venting)	10	--	--	--
Mulina lateralis	--	--	--	recently pre-dated
Polychaeta				
Polychaete sp.	4	--	--	--
Crustacea				
Cancer irroratus	20+	10+	27	32
Crangon septemspinosa	ubiq.	--	--	--
Libinia emarginata	--	--	3	1
Neomysis americana	ubiq.	ubiq.	--	--
Pagurus longicarpus	20+	2	6	--
Pagurus pollicaris	--	--	2	--
Echinodermata				
Asterias forbesii	15	4	15	47
Pisces				
Paralichthys oblongus	1	--	--	--
Pseudopleuronectes americanus	4	--	--	3
Scopthalmus aquosus	6+	--	2	--
Raja erinacea	--	--	--	1
Urophysis sp.	--	--	1	1

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TABLE III-3-12

Summary of Diver Operated Epibenthic Samples, FVP Dredge Disposal Site - Post Disposal Stage, 25 May 1983

Species	Quantitative Abundance	
	NE Border	N Border
Cnidaria		
Bougainvillia sp.	1 colony	--
Gastropoda		
Nassarius trivittatus	168	48
Retusa canaliculata	--	396
Bivalvia		
Gemma gemma	5,595	5,491
Nucula proxima	13,550	11,601
Pandora gouldiana	165	211
Yoldia limatula	125	1,229
Polychaeta		
Nephtys incisa	25	7
Crustacea		
Neomysis americana	187	4
Pagurus longicarpus	2	2

epibenthic samples. For future diver orientation, a 20m, north/south transect line was deployed across the dredged material border with its center at the Loran-C coordinates 25535.4/44000.8.

The following week, on 3 June, surveys were conducted to delineate the east and southwest borders of the FVP dredge disposal site and to survey sediment surface conditions, sample species types and abundances, and to mark the perimeters of the dredged material.

The Loran-C coordinates were 43999.2/26532.6 for the eastern border and 43999.7/26537.0 for the southwest border (Fig. III-3-41). The surface sediment at the eastern border had smooth topography with 0.5 - 1.0 cm of natural light brown sediment overlying 3-5 mm of BRH dredged material. Motile epifauna consisting of crustaceans and benthic fish were observed on both sides of the boundary. Diver collected epibenthic samples revealed a heavy concentration of sedentary epifauna both over dredged material and natural bottom (Table III-3-13). Table III-3-14 summarizes the quantification of both epibenthic samples. The qualitative densities at these sites are similar to those obtained at the north and northeast borders on 25 May. A 100 m transect line, incremented at 5 m, was deployed east and west over the border such that stations numbered 0 to 10 are in spoil material and stations numbered 10 to 20 are on natural sediment.

The surface sediment at the southwestern border region had smooth topography and 0.5 cm of dredged material at the border region. Dredged material thickness gradually thinned out from 4-5 cm at Loran-C coordinates 43999.2/26536.4 to 0.2 - 0.5 cm of spoil material at the coordinates 44000.0/26537.6. Motile epifauna were also observed at this site as three species of crabs, two species of fish, starfish, Asterias forbesi, and a channeled whelk, Busycon caniliculatum.

Bioturbation was more evidenced at the SW site than the E site where three 6 - 10 cm diameter vertical burrows and six 2-3 cm diameter burows were observed. These burrows were probably constructed by Homarus americanus and/or Squillia empusa. No large burrows were sighted at the eastern site, but it is assumed that the predation upon the rich upper infauna communities by the observed motile macro-epifauna equally accounts for significant bioturbation.

On 15, 17 and 22 June 1983, divers observed sediment surface conditions and surveyed and sampled species types and abundances at the center, eastern border and northern border of the FVP Dredged Disposal Site.

At the center of the FVP disposal site, there was 0.5 m of dredged material covering the natural bottom. At approximately 50 m west of the center, the depth was 15-20 cm. Throughout the transect, the dredged material was a soft, anoxic black sediment that was extremely flat without clay clumps or

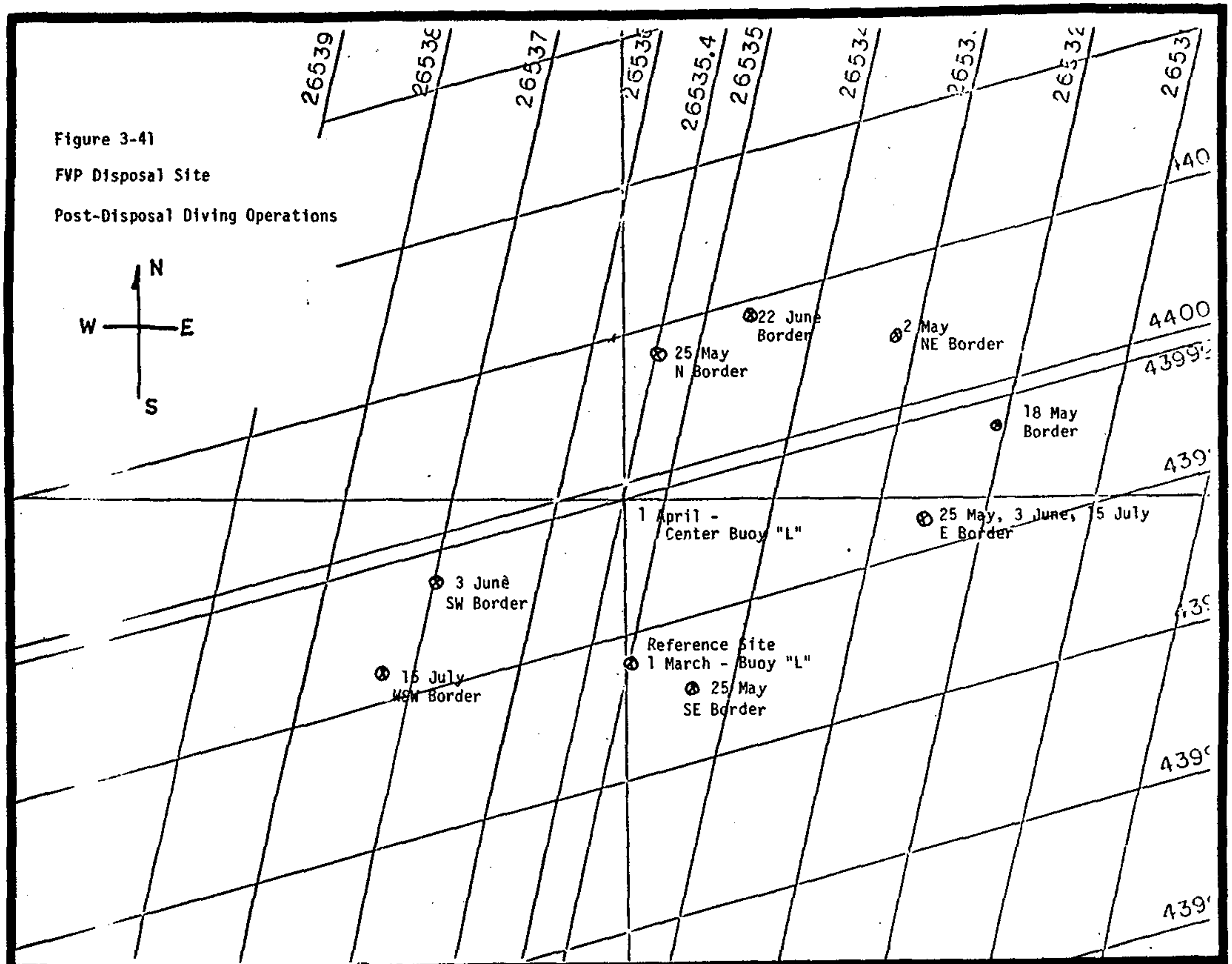

FIGURE III-3-41. Summary of Diver Operated Epibenthic Samples, FVP Dredge Disposal Site - Post Disposal Stage.

TABLE III-3-13

Diver Visual Species Observation FVP Dredge Disposal Site - Interim Stage, 3 June 1983

Species	Relative Abundances	
	E Border	SW Border
Gastropoda		
Busycon caniliculatum	--	1
Crustacea		
Cancer irroratus	27	26
Libinia emarginata	--	2
Pagurus longicarpus	30	35
Mysid swarms	ubiq.	--
Echinodermata		
Asterias forbesi	--	3
Pisces		
Pseudopleuronectes americanus	1	7
Scopthalmus aquosus	5	1

TABLE III-3-14

Summary of Diver Operated Epibenthic Samples Taken at the Eastern Border of the FVP Dredge Disposal Site - Post Disposal Stage, 3 June 1983

Species	Quantitative Abundance	
	ON MOUND	OFF MOUND
Cnidaria		
Bougainvillia sp.	1 colony	--
Gastropoda		
Lunatra heros	--	60
Nassarius trivittatus	71	41
Retusa canaliculata	1,485	720
Turbonilla sp.	--	120
Bivalvia		
Gemma gemma	2,660	1,830
Nucula proxima	18,035	16,540
Yoldia limatula	100	60
Polychaeta		
Nephtys incisa	24	2
Crustacea		
Neomysis americana	15	--
Pagurus longicarpus	3	1

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dredged deposit contours. Only two 20-30 cm peat clumps protruding from the surface were notable features during the entire diver transect. Bioturbation at this center site was observed from Cancer irroratus, Pseudopleuronectes americanus, Crangon septemspinosa, Yoldia limatula and unknown burrowing polychaetes.

At the eastern border of the disposal site, the divers located the 100 m east/west transect line that was deployed on 3 June 1983. During this survey, 2 weeks later, washed-out 10-15 cm clay clumps and approximately 2 cm of dredged material was observed at station 13 outside of the previous border. The border of the dredged material was delineated near station 14 with approximately 2 mm of dredged material under 1 cm of oxidized natural sediment. The topography was flat and featureless from stations 14 through 20. This evidence of dredged material migration was the probable result of tidal current erosion. An epibenthic sample was taken on natural sediment for 30 seconds due east of station 20 to contrast the sample taken at the center of the disposal site. Appendix III, Plates 3-29 through 3-32 photodocument some sediment surface and biotic conditions 70 meters west of the site center on 15 June 1983.

Surveys of the northern border were performed on 17 and 22 June 1983. Natural sediment encountered on 17 June was flat and featureless with a fine light brown silty sediment, a 1 to 2 mm nepheloid layer, and no observable shell hash. Bioturbation at this site was extensive with Urophysis sp., Loligo peali, Cancer irroratus, Busycon canaliculatum and Nassarius trivittatus being observed during the transect. On 22 June 1983, a survey was performed in the same area over the dredged material. At this location, bioturbation by macro-epifauna appeared reduced with only five Pseudopleuronectes americanus, three Nassarius trivittatus and ten Pagurus longicarpus sighted during the entire transect.

Table III-3-15 summarizes species observed and their relative abundance from diver observations at the center, east border, and north border sites. Table III-3-16 summarizes the three epibenthic samples taken on dredged material at the center site, off the dredged material at the eastern border and at the northern border site. No generality could be made from the visual data between these three locations, but the epibenthic sample data revealed high community diversity and abundance at the FVP disposal site.

The south and southwest borders of the BRH material were surveyed on 15 July. The east-west transect line deployed on 3 June was also examined. General sediment conditions at the east-west transect line deployed across the eastern border revealed a patchy distribution of dredged material in this area. On 3 June 1983, the 100 m transect line was positioned 50 m over the dredged material (stations 0-10 to the west) and 50 m over natural sediment (stations 11-20 to the east). At the time of this survey, six weeks after the transect deployment, the

TABLE III-3-15

Summary of Diver Visual Species Observations, FVP Dredge Disposal Site, Post Disposal Stage.

Species	Relative Abundance			
	15 June Center	15 June E border	17 June N border	22 June N border
Gastropoda				
Busycon canaliculatum	--	--	1	--
Nassarius trivittatus	--	--	--	3
Bivalvia				
Yoldia limatula	4	--	--	--
Polychaeta				
polychaete sp.	3	--	40 tubes/m^2	--
Cephalopoda				
Loligo peali	--	--	1	--
Crustacea				
Cancer irroratus	50^+	2/m^2	2	--
Crangon septemspinosa	4	--	--	--
Pagurus longicarpus	--	12/m^2	5/m^2	10
Echinodermata				
Asterias forbesi	--	--	1	--
Pisces				
Pseudopleuronectes americanus	2	3	--	5
Raja erinacea	--	1	--	--
Scopthalmus aquosus	--	1	--	--
Urophysis sp.	--	--	1	--

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TABLE III-3-16

Species	Quantitative Abundance 15 June Center[1]	15 June E Border[2]	17 June N Border[2]
Gastropoda			
Nassarius trivittatus	4	6	20
Retusa canaliculata	175	600	1,860
Turbonilla sp.	--	--	240
Bivalvia			
Gemma gemma	1,385	1,675	14,411
Nucula proxima	357	5,225	6,498
Pandora gouldiana	--	25	4
Yoldia limatula	100	475	1,867
Polychaeta			
Nephtys incisa	23	1	64
Crustacea			
Cancer irroratus	1	--	--
Cancer megalopa	1	--	--
Caprella sp.	1	--	--
Crangon septemspinosa	1	1	5
Neomysis americana	81	11	214
Pagurus longicarpus	--	--	2
cumacean sp.	2	--	--
Pisces			
Pseudopleuronectes americanus	1	--	--

1. On dredged material.
2. Off dredged material.

boundary was not distinct and only patchy areas of dredged material were found from stations 0-4. This is good evidence of the initial spreading and then mixing of the dredged material over and into the natural sediment. Considerable biological activity of motile epifauna was observed over the entire eastern border region as shown in the field logs presented in the Appendix. Consequently, bioturbation must be assumed to have a significant impact on the area and it is a probable factor in the patchy distribution of the dredged material that was observed during this dive.

The south and southwest border regions of the BRH material are analogous to the previous border areas described. The upper 2-3 cm of sediment is light brown natural sediment or fully oxidized dredged material with less than 1% shell hash and is flat and featureless. Below the oxidized layer was a 2-3 cm black layer of cohesive clay. This layer tapered to patchily distributed areas of less than 0.5 cm in thickness.

Table III-3-17 summarizes the biological observations at the three border areas. Table III-3-18 documents the epibenthic sample taken on natural bottom outside the WSW border.

The last post-disposal surveys were conducted on 30 and 31 August. At the center of the FVP disposal site, there was 1 cm of oxidized sediment over black anoxic mud. The sediment was of a silt-clay consistency with ∿1 mm nepheloid veneer. The sediment surface was largely featureless except for six eroding clumps of cohesive clay of 10-30 cm in diameter and 2-3 patches (∿1 m^2) of shell hash. There was no perceptible slope during the transect to and across the southern border.

The southern border of the dredged material was not distinct except that the oxidized top layer of sediment increased to 2 cm and the anoxic bottom layer became less silty. Bioturbation activity was uniform during the entire transect from the middle of the site to natural bottom. The starfish, _Asterias forbesi_, the channeled whelk, _Busycon canaliculatum_, and numerous finfish and crabs were observed on the sediment surface. A single, 7 cm diameter vertical burrow, possibly constructed by _Homarus americanus_, was noted at the dredged material border. Table III-3-19 summarizes the species observed during the entire transect.

A hand-held diver epibenthic sample was taken on the dredged material to obtain a quantitative estimate of the infauna. Table III-3-20 presents the analysis of the epibenthic sample and shows a moderate concentration of sedentary fauna, typical of weathered disposal sites in Long Island Sound. Appendix III, Plates 3-33 through 3-38 photodocument biotic and abiotic site conditions.

At the M buoy anchor (Fig. III-3-41), there was 1 cm of oxygenated surface sediment underlaid by 1-2 cm of black material which laid over a natural bottom base of grey silt/clay. At this site, there was evidence of extensive bioturbation from

TABLE III-3-17

Summary of Diver Visual Species Observations, FVP Dredge Disposal Site Post Disposal Stage.

Species	Relative Abundance 15 July 400 m E Border	15 July WSW Border	15 July S of Center
Cnidaria			
Ceriantheopsis americanus	5	--	--
Gastropoda			
Busycon canaliculatum	1	--	--
Nassarius trivittatus	100+	--	--
Crustacea			
Crangon septemspinosa	4	--	--
Homarus americanus - claw only	--	--	*
Pagurus longicarpus	100+	--	3
Pagurus pollicaris	6	--	--
Echinodermata			
Asterias forbesi	--	1	$7/m^2$
Pisces			
Pseudopleuronectes americanus	12+	--	--
Scopthalmus aquosus	3	--	--

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TABLE III-3-18

Summary of Epibenthic Sample over Natural Sediment WSW of FVP Disposal Site Center - Post Disposal Stage

Species	Quantitative Abundance Off Dredged Material, 15 July 1983
Chaetognatha	
Sagitta sp.	10
Gastropoda	
Nassarius trivittatus	10
Retusa canaliculata	1,289
Turbonilla sp.	48
Bivalvia	
Gemma gemma	1,361
Mulina lateralis	1,464
Pandora gouldiana	6
Yoldia limatula	477
Polychaeta	
Nephtys incisa	8
Crustacea	
Cancer irroratus	13
Crangon septemspinosa	245
Neomysis americana	46
Pagurus longicarpus	3
cumacean sp.	12
Echinodermata	
Asterias forbesi	1

TABLE III-3-19

Summary of Diver Visual Species Observations FVP Dredge Disposal Site, South Transect from Center - Post Disposal Site, 30 August 1983

Species	Relative Abundance
Anthozoa	
anemone sp.	1
Gastropoda	
Busycon canaliculatum	1
Crustacea	
Cancer irroratus	5
Crangon septemspinosa	10/0.25 m^2
Pagurus longicarpus	2/0.25 m^2
Pisces	
Paralichthys oblongus	3
Pseudopleuronectes americanus	5
Scopthalmus aquosus	5
Tautogolabrus adspersus	2
Echinodermata	
Asterias forbesi	8

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TABLE III-3-20

Summary of Diver Operated Spibenthic Sample, South Border FVP Dredge Disposal Site - Post Disposal Stage, 30 August 1983

Species	Quantitative Abundance
Bivalvia	
Gemma gemma	134
Mulina lateralis	56
Nucula proxima	4
Yoldia limatula	14
Gastropoda	
Nassarius trivittatus	263
Polychaeta	
Nephtys incisa	14
Crustacea	
Crangon septemspinosa (incl. 40 berried females)	327
Neomysis americana	100
Pagurus longicarpus	4
amphipoda	1
cumacean sp.	1
Pisces	
Prionotus sp.	1

burrowing crustacea and feeding depressions by decapods and finfish. Concentrations of small Mulinia lateralis and Gemma gemma shells comprised 5% of the total sediment surface and were suspected to be the result of Asterias forbesi feeding activity.

At the L buoy (Fig. III-3-41) center site, the sediment was soft and unconsolidated. A diver could easily penetrate 0.75+ m into the surface sediment. A 1-2 cm light brown mobile surface layer was underlaid by 1+ m of black course anoxic silt. Some patchy areas, 5-10 cm in diameter, of coarse gravel were located south of the L buoy anchor. Two percent of the sediment surface coverage was by wood, metal and peat debris.

Epibenthic fauna were estimated to be 50% less at the center site than at 400E. Approximately 12 decapod excavations were seen over the entire southerly transect and the only bioturbating species sighted were one Prionotus carolinus, 6 Cancer irroratus, 10 Nassarius trivittatus and one Busycon canaliculatum. Table III-3-21 summarizes the diver species counts for both sites surveyed. Appendix I, Plates 3-39 through 3-43 provide photodocumentation of the conditions at either site.

3.5 Suspended Sediment Observations

3.5.1 Pre-Disposal

Deployment NHDD01, 15 August - 3 September 1982

During this period, suspended materials concentrations adjacent to the FVP site averaged approximately 7 mg/l and displayed a regular periodicity coincident with the local tidal cycle (Fig. III-3-42). Concentrations during each tidal cycle were observed to vary by approximately 10 to 20% about the mean with maxima approaching 10 mg/l while minima equalled approximately 6 mg/l. Within this regular cycling, large amplitude, short duration perturbations occurred aperiodically with indicated concentrations in excess of 50 mg/l. The cause of these variations cannot be simply specified. Review of the meteorological data provided by the National Weather Service station at Bridgeport (Sikorsky Memorial Airport), Connecticut indicated no significant storm events during the observation period and winds generally less than 12 knots and an absence of major precipitation. The data suggest that the indicated perturbations are most probably the result of a variety of factors including advection of macrophyte fragments or seagrasses, biological colonization, and/or the settling of materials from the water column on the windows of the optical sensors. Given the relatively large number of perturbations occurring during periods of low or decreasing concentrations, this latter mechanism appears dominant particularly during the immediate post-deployment interval. As direct biological fouling of the windows increases with deployment time, the relative importance of the individual perturbations decreases. During this August deployment, instrument outputs indicate that major fouling of the optical windows began during day 9 and, within approximately three days, effectively limited the utility of the optical sensors. Such fouling rates appear generally

TABLE III-3-21

Diver Visual Observation and Species Counts at the FVP Black Rock Harbor Dredge Disposal Site - Post Disposal Stage, 31 August 1983

Species	Relative Abundance	
	Site Center	400 m E
Anthozoa		
Cerianthus americanus	1	6
Bivalvia		
Gemma gemma	--	100+
Mulina lateralis	--	100+
Mytilus edulis	--	1 dead cluster of valves)
Gastropoda		
Busycon canniculatum	1	--
Nassarius trivittatus	10	--
Crustacea		
Cancer irroratus	6 (4 juv.)	8
Crangon septemspinosa	--	4
Libinia sp	--	1
Pagurus bernhardus	--	5
P. longicarpus	20	20+
Pisces		
Paralichthys oblongus	--	1
Prionotus carolinus	1	--
Pseudopleuronectes americanus	1	3
Totogalabrus adspersus	--	2
Cephalopoda		
Loligo sp.	--	egg cases only

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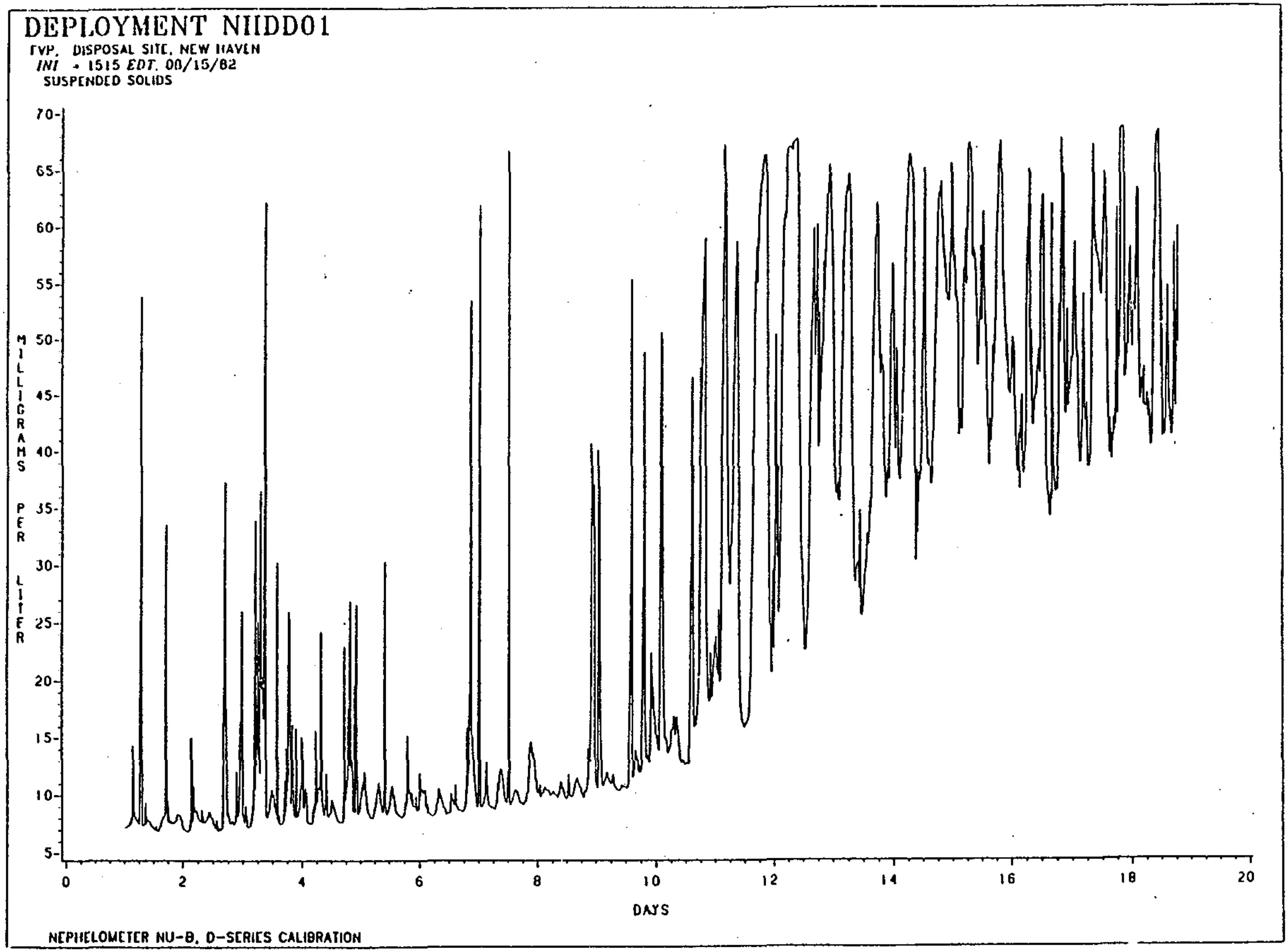

FIGURE III-3-42. Suspended Material Concentrations Deployment NHDD01 representative of summer conditions in Central Long Island Sound.

Concurrent water temperatures and conductivity/salinity during this deployment each display regular periodicity coincident with the local tidal cycle (Figs. III-3-43 and III-3-44). Characteristic water temperature variations equalled approximately 0.5°C, while salinity varied by 0.1 to 0.25°/oo. Temperatures also displayed a lower frequency variability with average values increasing progressively from 19.4°C to a maximum of 20.8°C over the first ten days of the deployment and then steadily decreasing to approximately 19.6°C by day 18 (2 September 1982). This temperature cycle was observed at Bridgeport and appears representative of a system in which there is relatively limited stratification throughout the water column. Necessarily, such an assumption cannot be simply verified in the absence of more detailed measurements over the vertical.

Near-bottom salinity during this deployment period (Fig. III-3-44) displayed only a minor long-term, low frequency variability with average values increasing progressively from approximately 27.5°/oo on deployment to 28.25°/oo on Day 18. This increase cannot be simmply correlated with local streamflow conditions and appears to be primarily the result of the near-drought conditions prevailing during the late summer months of 1982. The variations in the degree of temporal variability apparent over the deployment period appear to be the result of variations in tidal excursion caused by the neap-spring cycle. Minima are coincident with the neap portion of the cycle occurring during Days 6 through 12, while maxima occur during the intervening springs. Unfortunately, simple correlation with the near bottom tidal currents cannot be demonstrated due to malfunction of the savonius rotor.

Deployment NHDD02, 3 September - 5 October 1982

Apparent recovery of a fouled lobster trap resulted in disturbance and overturning of the instrumentation array during this deployment period. Several watertight connectors were damaged causing malfunction of the associated sensors and several units were buried within the sediment column. The combination resulted in minimal data recovery for this period.

Deployment NHDD03, 13 October - 18 November 1982

Suspended material concentrations during this deployment displayed a slight, but generally insignificant, increase over those observed during the August-September, 1982 deployment. Concentration levels averaged approximately 8 mg/l and again displayed the characteristic variability over each tidal cycle resulting in variations of approximately 10 to 20% about the mean (Fig. III-3-45). This variability decreased markedly during Days 8 through 13, apparently in response to the variations in tidal excursion induced by the bi-monthly

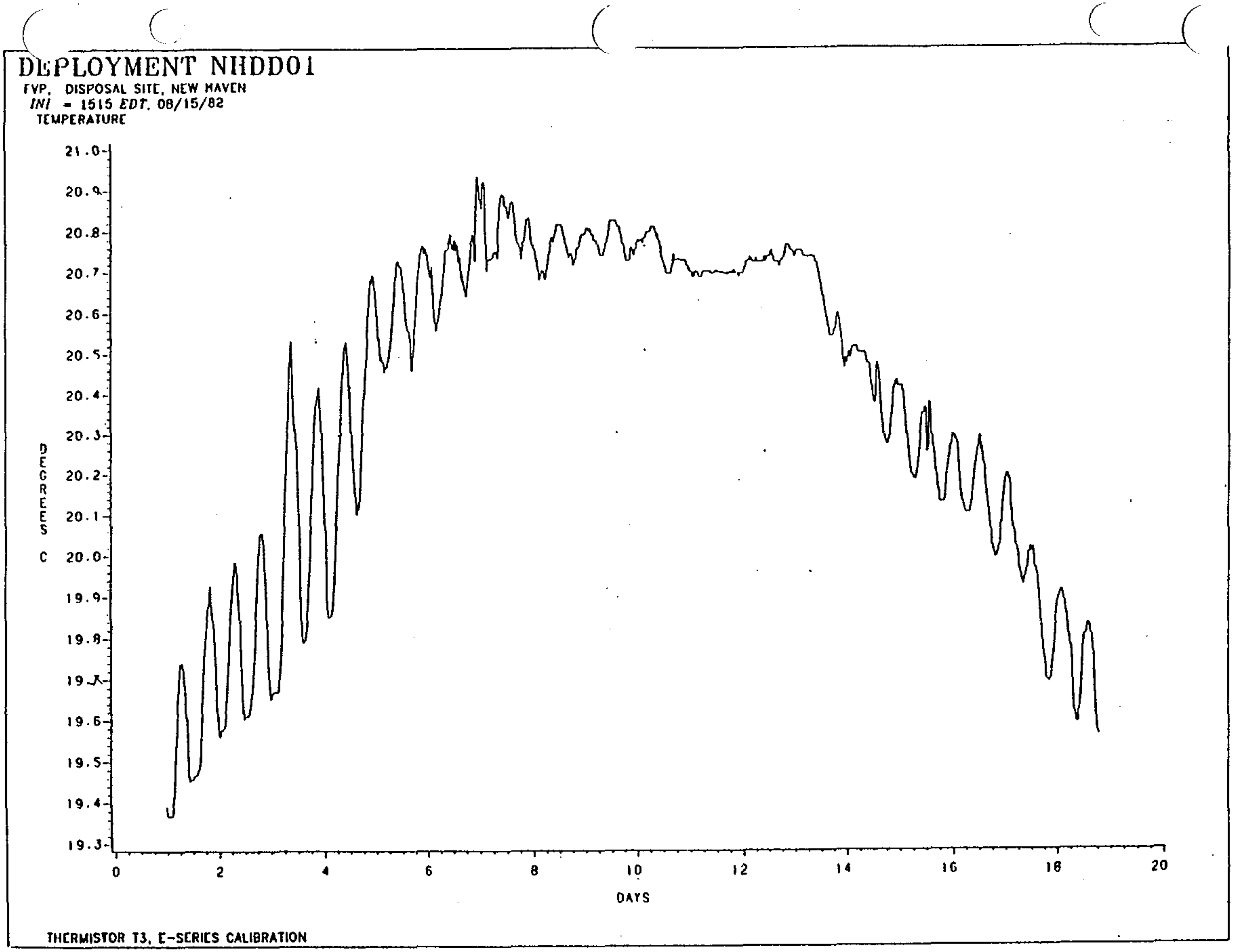

FIGURE III-3-43. Water Temperature-Near Bottom
Deployment NHDD01

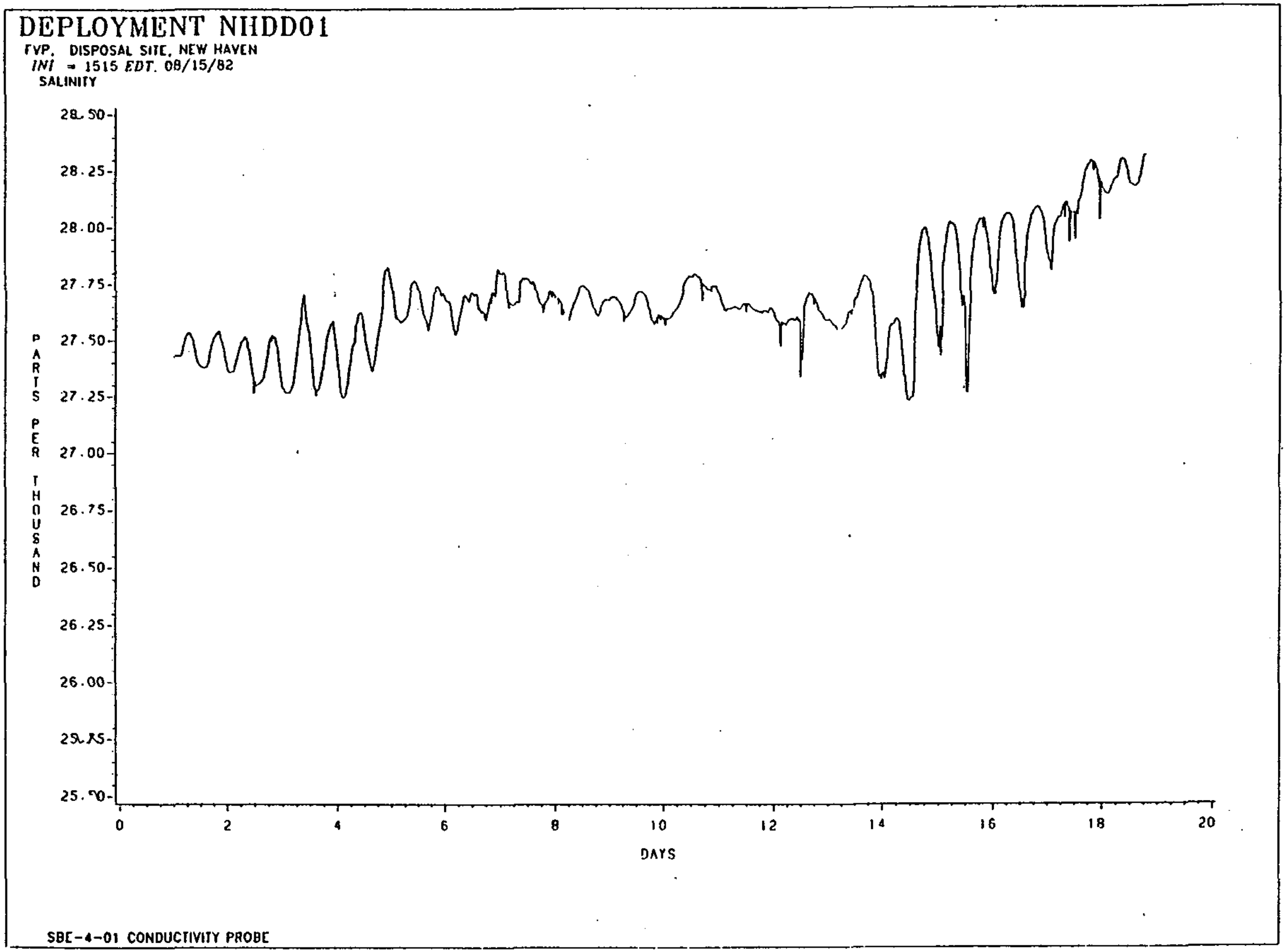

FIGURE III-3-44. Salinity-Near Bottom
Deployment NHDD01

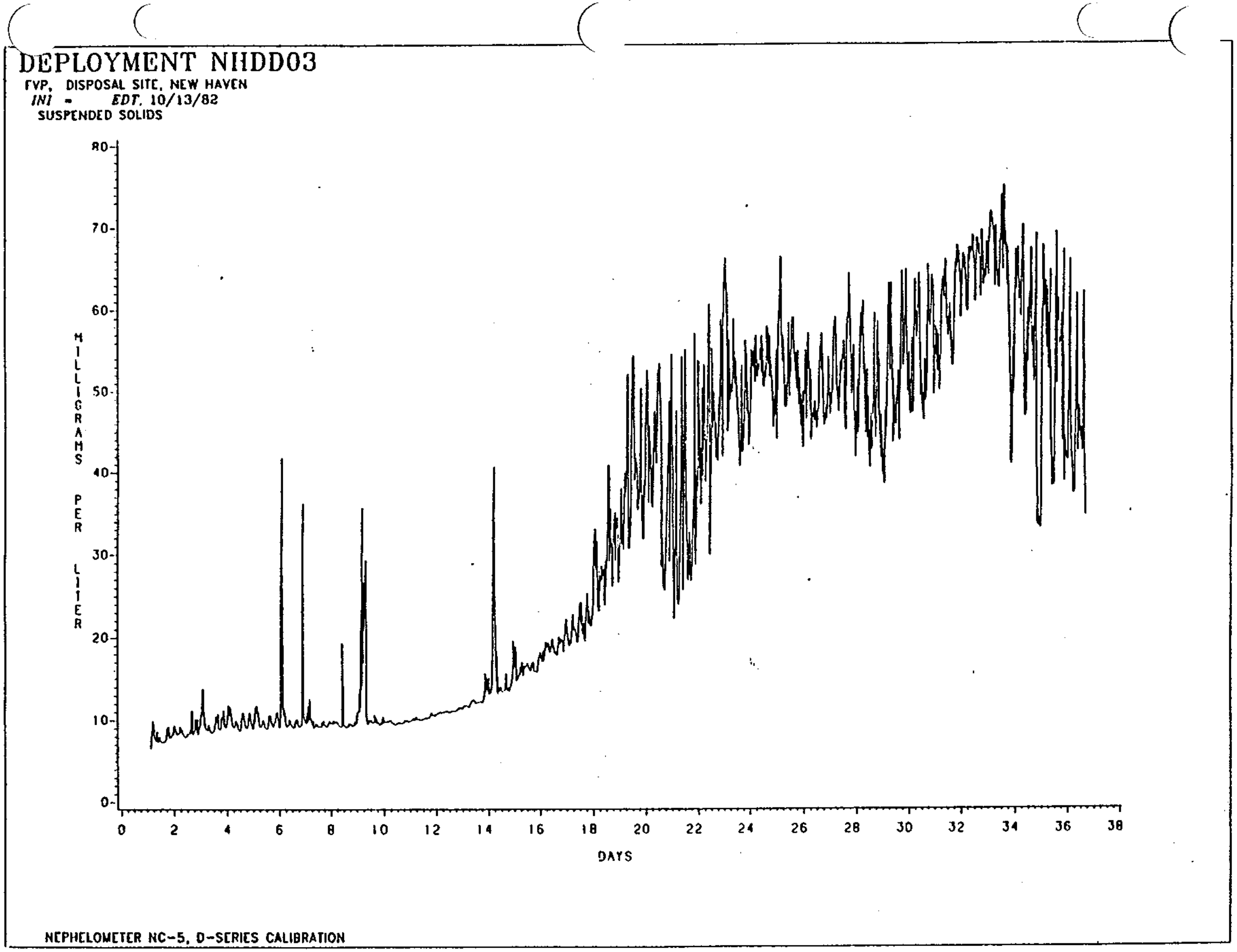

FIGURE III-3-45. Suspended Material Concentrations
Deployment NHDD03

neap-spring cycle. Again, this cannot be simply correlated with the near-bottom velocities due to major fouling of the savonius rotor.

The perturbations associated with the suspended material record are less pronounced than those observed during August in both amplitude and frequency. Review of the wind records provided by the Bridgeport station of the National Weather Service (Appendix III) indicate negligible correlation between these disturbances and concurrent winds suggesting that the variations are most probably the result of deposition of materials from the water column onto the windows of the optical sensors. The decrease in activity relative to that observed in August appears consistent with the general decrease in biological activity in the water column expected during this time of the year. The apparent decrease in sensor fouling rates indicated by the suspended material data appears consistent with this expected decrease in activity.

Water temperatures during this deployment period display a steady, generally persistent decrease, ranging from 18°C immediately post-deployment to approximately 13°C near the end of the deployment period (Fig. III-3-46). The correlation between these water temperatures and concurrent air temperature at Bridgeport (Appendix III) suggest reasonably close coupling between atmospheric and water column conditions and continues to appear representative of a system characterized by a minimum of stratification over the vertical of the water column.

Essentially coincident with the water temperature variations, salinity over the deployment period also displayed a persistent decrease with values ranging from approximately 28.5 °/oo to 26.8 °/oo (Fig. III-3-47). This decrease appears to be the result of a general increase in streamflows over the deployment period in response to increasing precipitation. As in the case of the water temperatures, the relatively short response times between the occurrence of a precipitation/streamflow event and the observed decrease in salinity suggests reasonably rapid mixing and/or conditions representative of moderate stratification over the vertical of the water column. Concurrent higher frequency variations in both salinity and water temperature over this deployment period appear essentially coincident with the bi-monthly neap-spring cycle.

<u>Deployment NHDD04, 18 November - 8 December 1982</u>

Suspended material concentrations during this deployment period displayed a slight, but persistent, increase in average values ranging from approximately 6 mg/l immediately after deployment to 10 mg/l by Day 18. Regular variations over each tidal cycle continued to occur in a manner similar to that observed during the August and October deployments, although data scaling effectively masks the variations in the plotted results (Fig. III-3-48). Reviews of the meteorological data from the Bridgeport station indicate a virtual absence of significant wind and/or storm events during the deployment period suggesting that

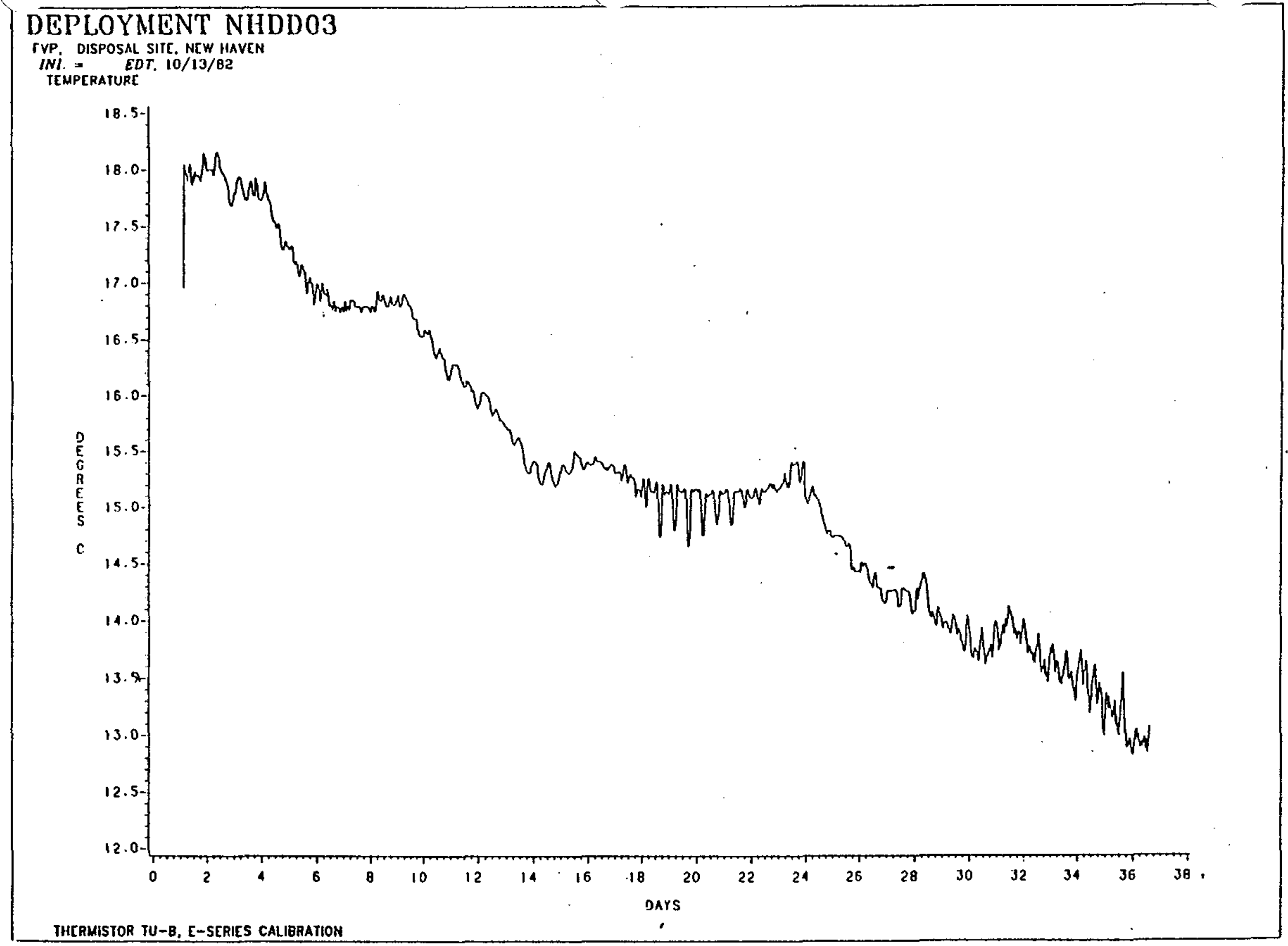

FIGURE III-3-46. Water Temperature-Near Bottom Deployment NHDD03

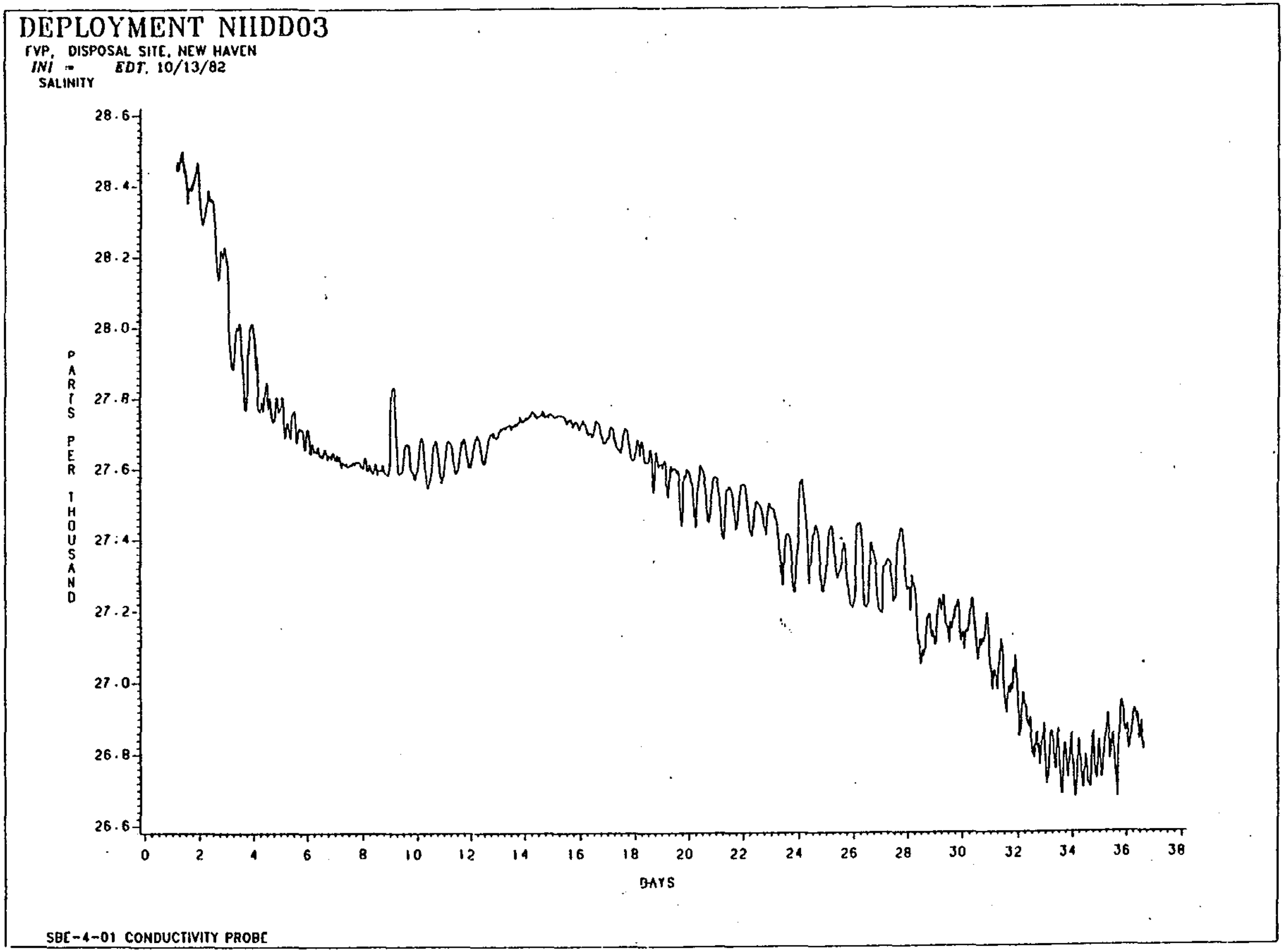

FIGURE III-3-47. Salinity- Near Bottom
Deployment NHDD03

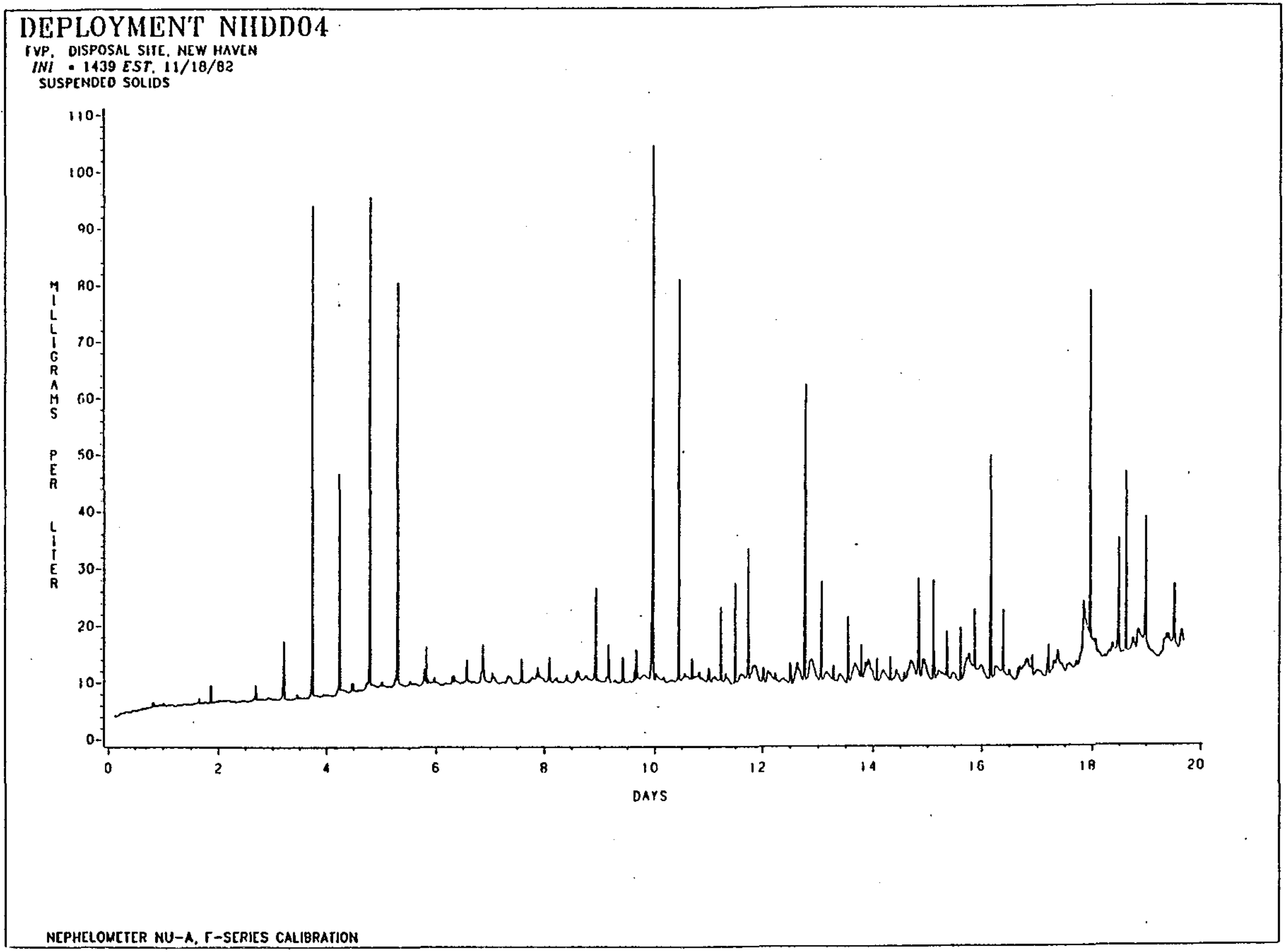

FIGURE III-3-48. Suspended Material Concentrations
Deployment NHDD04

the aperiodic perturbations in the record are most probably the result of deposition of suspended materials onto the windows of the optical sensors rather than increased resuspension of sediment from the sediment-water interface. The apparent increase in background suspended material conccentrations also appears to be primarily the result of particulate settling from the water column. The persisting increase after each of the large amplitude, short duration, perturbations suggest some degree of retention on the optical windows of materials deposited during low velocity conditions. Concurrent biological fouling over this deployment period was apparently negligible.

Water temperature continued the seasonal decline initiated in late August with values falling to approximately 12°C on Day 20 (Fig. III-3-49). The low frequency variations over this period were essentially coincident with air temperature trends observed at Bridgeport. These latter data indicated air temperatures decreasing but slowly during the first six days of the deployment period followed by an interval of rapidly decreasing values reaching the monthly minimum on 28 November, or Day 10. For the remainder of the month, air temperatures remained essentially constant or increased slightly. This trend continued into the early days of December 1982. Overall, it appears essentially similar to the pattern displayed by concurrent water temperature.

The higher frequency variations in water temperature displayed marked variability over the deployment period. In general, this variability is correlated with the bi-monthly neap-spring cycle. Comparisons with the current meter data for the period (Fig. III-3-50) indicate spring conditions during Days 0-4 and 9-16. These are clearly the periods of maximum high frequency variability. The increased variability associated with the water temperatures following Day 10 appears to be the result of an increase in the spatial variability characterizing the temperature field following the rapid drop in air and associated water temperatures. This variability appears to decrease slowly with time as mixing leads to increased homogeneity within the temperature field.

Salinity during this deployment period displayed (Fig. III-3-51) a general decrease with values ranging from approximately 28.5 °/oo immediately post-deployment to 28.35 °/oo on Day 18. The causes of the observed low-frequency variations are difficult to accurately specify and appear to be primarily the result of short-term variations in regional streamflow acting in combination with characteristic mixing processes active within the western Sound. This latter factor introduces significant temporal lags in the response of the salinity field to variations in freshwater input and thereby complicates simple correlation with streamflow. As in most of the preceeding records, the higher frequency variability within the salinity record appears to be simply the result of variations in tidal excursion associated with the bi-monthly spring-neap cycle.

Examination of the current meter data for the deployment period indicates, as noted above, the clear signature

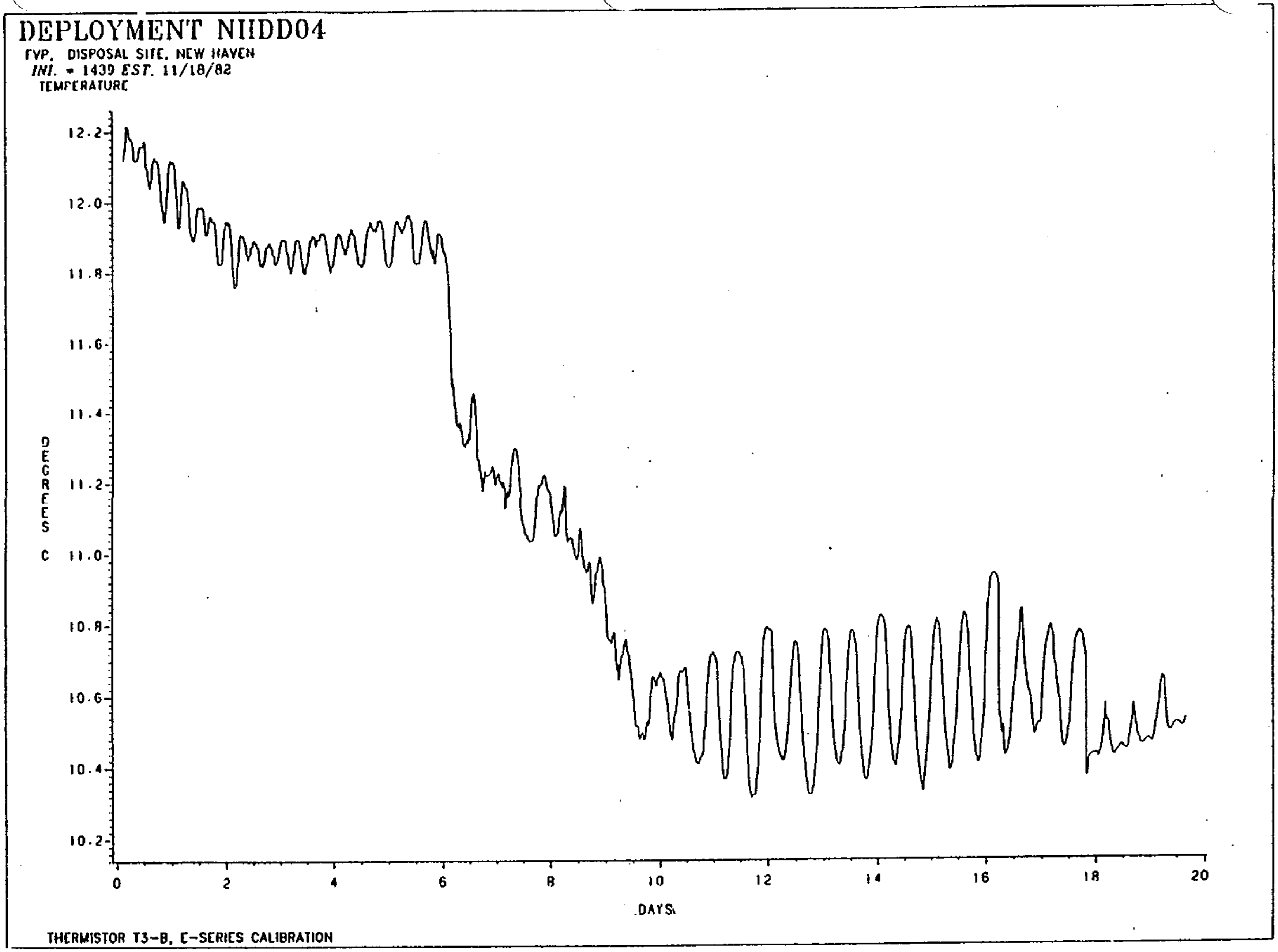

FIGURE III-3-49. Water Temperature- Near Bottom
Deployment NHDD04

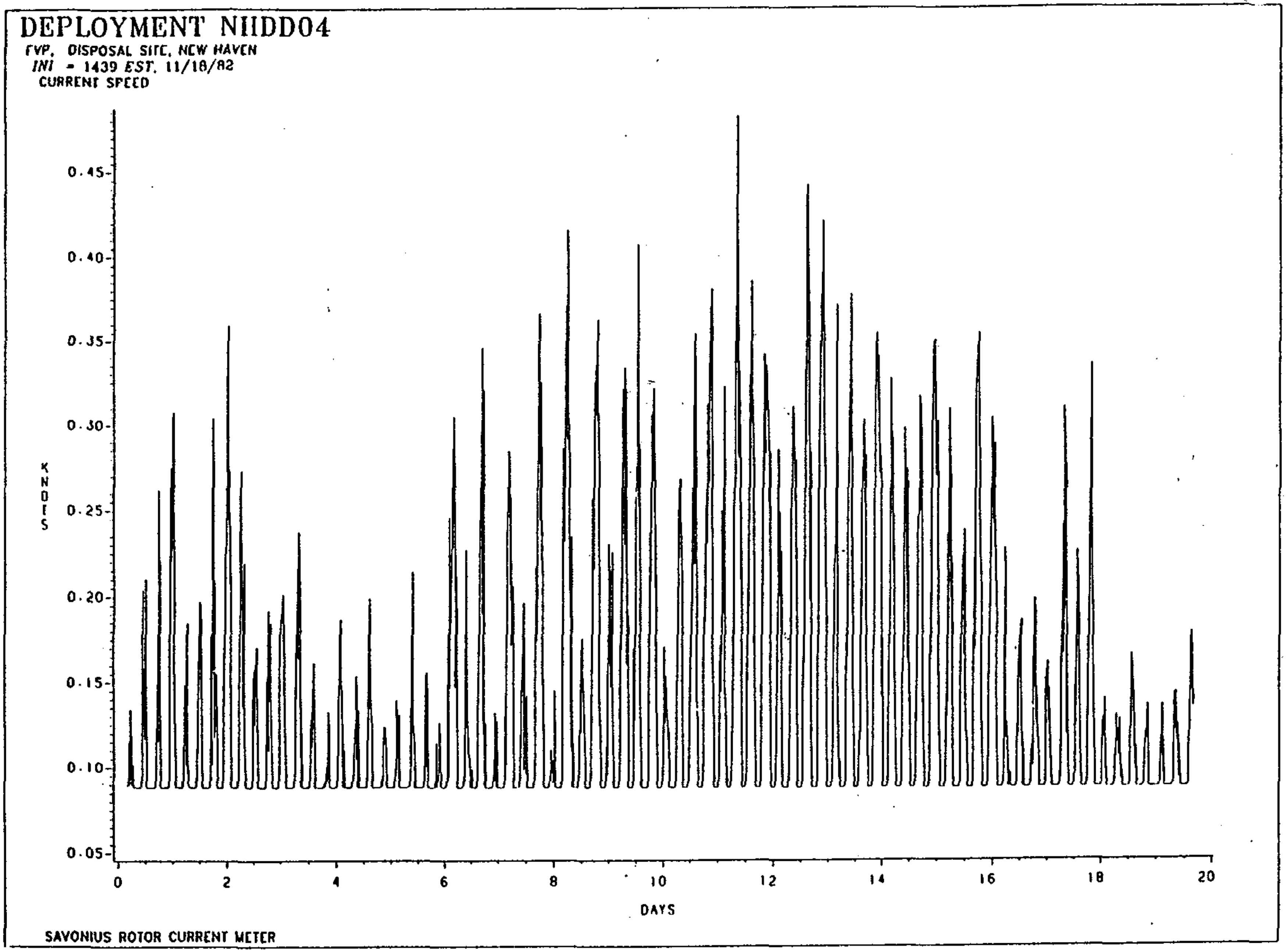

FIGURE III-3-50. Current Speed
Deployment NHDD04

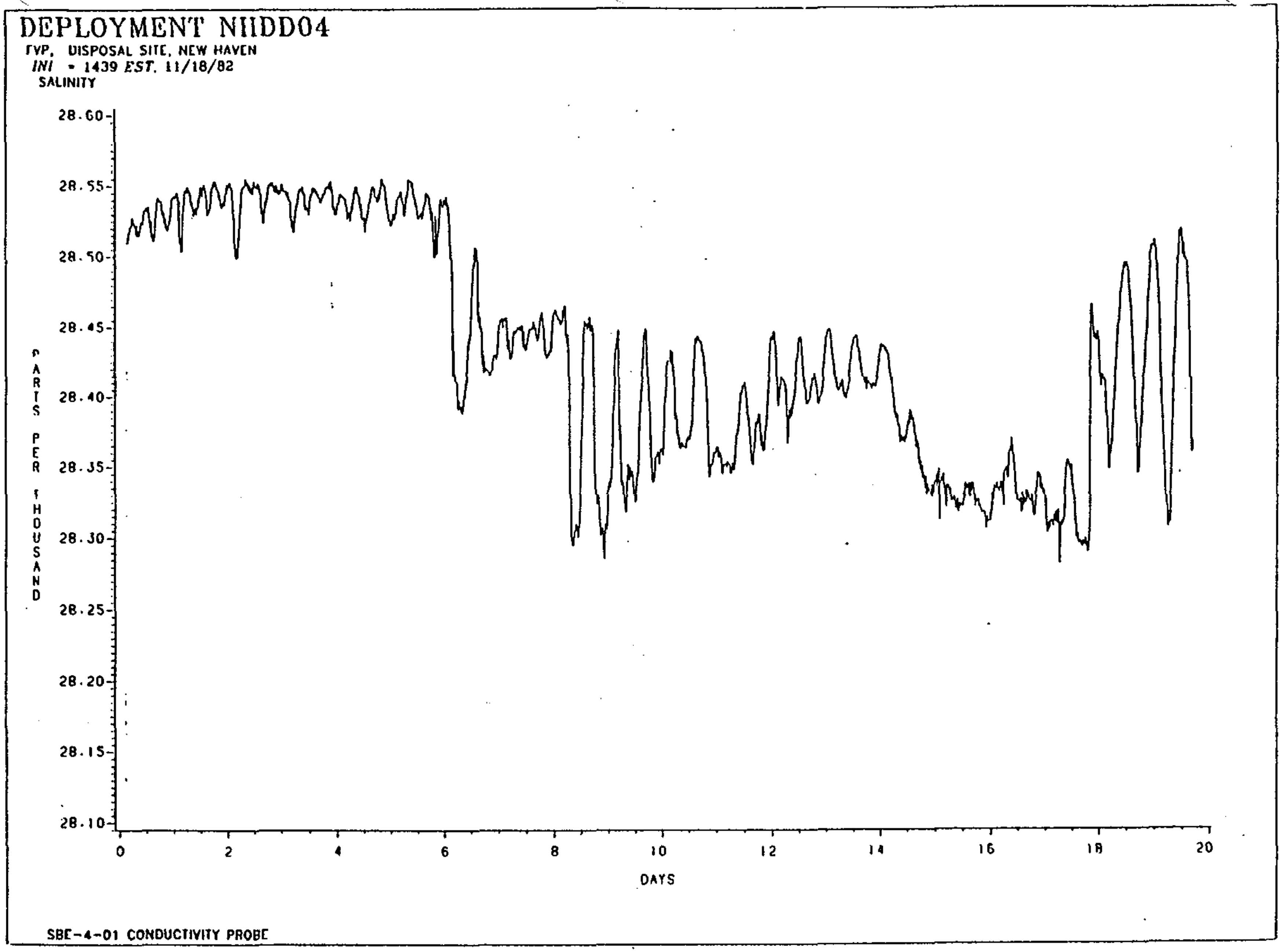

FIGURE III-3-51. Salinity- Near Bottom
Deployment NHDD04

associated with the bi-monthly neap-spring cycle. This cycle resulted in maximum current speeds which varied from slightly less than 0.15 knot during neaps to approximately 0.45 knot during springs. Between these extremes, the maximum current speed displayed significant temporal variability characterized by an evident diurnal cycle (Fig. III-3-50). Beyond the apparent variations induced by the local tidal characteristics, the cause of these variations cannot be simply specified. Review of the meteorological data from the Bridgeport station (Appendix III) indicates a general absence of significant storm events during the deployment period and a persistence of relatively low-energy wind conditions. These variations appear, therefore, to be most probably the result of a combination of tidal factors and inaccuracies introduced by the savonius rotor. These latter inaccuracies appear to be most pronounced at low current speeds, suggesting that they are the result of bearing wear or increased rotor friction due to fouling or the accumulation of sediments within the bearing housing. Periodic servicing appears to have reduced the incidence of such instrument related inaccuracies.

Deployment NHDD05, 8 December - 27 December 1982

In comparison to the previous deployment periods at the FVP site, suspended material concentrations during this deployment period displayed a moderate to high degree of variability over a variety of temporal scales (Fig. III-3-52). At the lowest frequency, concentrations decreased from approximately 12 mg/l immediately post-deployment to slightly more than 10 mg/l by Day 18. This trend is contrary to most of the previously observed variations and suggests that fouling and/or particulate settlement onto the optical windows was essentially negligible during this deployment period. Such behavior appears consistent with winter conditions at the Central Long Island Sound sites.

As frequency increases, several ranges of variability are apparent in the suspended material record. At the lower end, concentrations display cycling having a two to four day period. The cause of this variation cannot be simply specified. Such periodicity is not apparent within the available meteorological data or the local current meter records. It appears to be most probably an artifact associated with the retention of particulate materials within the sampling chamber of the optical sensors. Fractions of the materials suspended during periods of relatively high current speeds settle and are retained within the sampling chamber resulting in a decrease in light transmission and an apparent increase in the indicated amounts of material in suspension. As current speed increases, associated resuspension decreases, favoring conditions in which particulate settling becomes negligible while the previously deposited materials are slowly eroded or selectively winnowed from within the sampling volume. This removal results in a slow increase in light transmission and is evidenced by an apparent decrease in the sensor-indicated concentration of suspended materials. Such conditions persist until the current speed again reaches levels

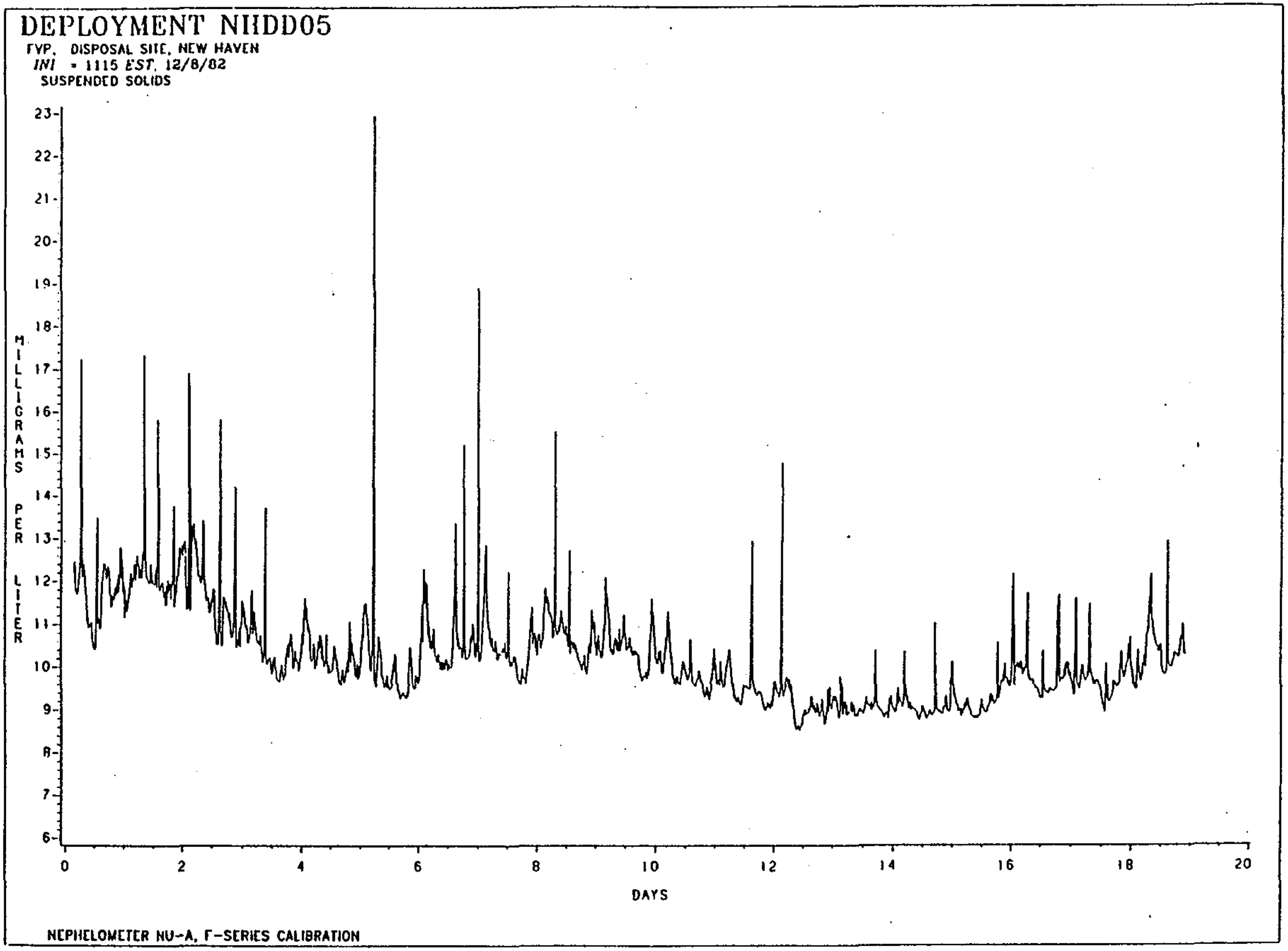

FIGURE III-3-52. Suspended Material Concentrations
Deployment NHDD05

sufficient to cause major resuspension of materials from the sediment-water interface. Although admittedly hypothetical, this construct appears reasonably consistent with the current meter data (Fig. III-3-53), showing intermediate frequency variability having periods of approximately 4 days.

At semi-diurnal periods, the suspended material concentrations display clear variability in response to the dominant tidal frequency. During this deployment period, these tidal variations result in concentrations that vary by approximately 10 to 20% about the mean. This range of variability itself varies in response to maximum speed. Such variability suggests that the suspended materials are, for this time of year, supplied primarily by resuspension from the sediment-water interface with water column contributions representing a relatively minor fraction.

The regular tidal variability is disturbed aperiodically by large amplitude, short duration peaks in concentration. The cause of these perturbations cannot be simply specified. Within the meteorological data from the Bridgeport National Weather Service station, there is no evidence of significant storm events and, as noted above, contributions due to particulate settling from the water column appear to be relatively minor during this time of the year. The peaks, therefore, appear to be primarily the result of the accumulation of particulates resuspended from the sediment-water interface within the sampling chamber of the optical sensors. This appears to be a relatively infrequent phenomenon occurring primarily during the spring portion of the tidal cycle at intervals characterized by generally low current speeds. Since these peaks do not cause a marked increase in indicated background concentrations, it would appear that the associated accumulation is relatively short-lived with materials being removed from the optical windows during the next period of reasonably high current speed.

Water temperatures during this deployment period continued to display a progressive decrease with values ranging from approximately 10.5^{o}C immediately post-deployment to slightly more than 6.5^{o}C on Day 18 (Fig. III-3-54). Again this trend appears to be reasonably well correlated with that displayed by air temperature records obtained at Bridgeport (Appendix III).

Near bottom salinity remained relatively invariant throughout the deployment period, with values equalling approximately 28.5 ^{o}/oo $\pm$ 0.20 ^{o}/oo. Values display a clear correlation with tidal phase with the range of variability changing progressively over the course of the spring-neap cycle. The single evident excursion from this simple pattern occurred during Days 6 through 11 (Fig. III-3-55). This was a period characterized by below-average air temperatures and above-average precipitation. Although cause and effect is difficult to establish, this combination appears to have been sufficient to modify salt distributions most probably through variations in

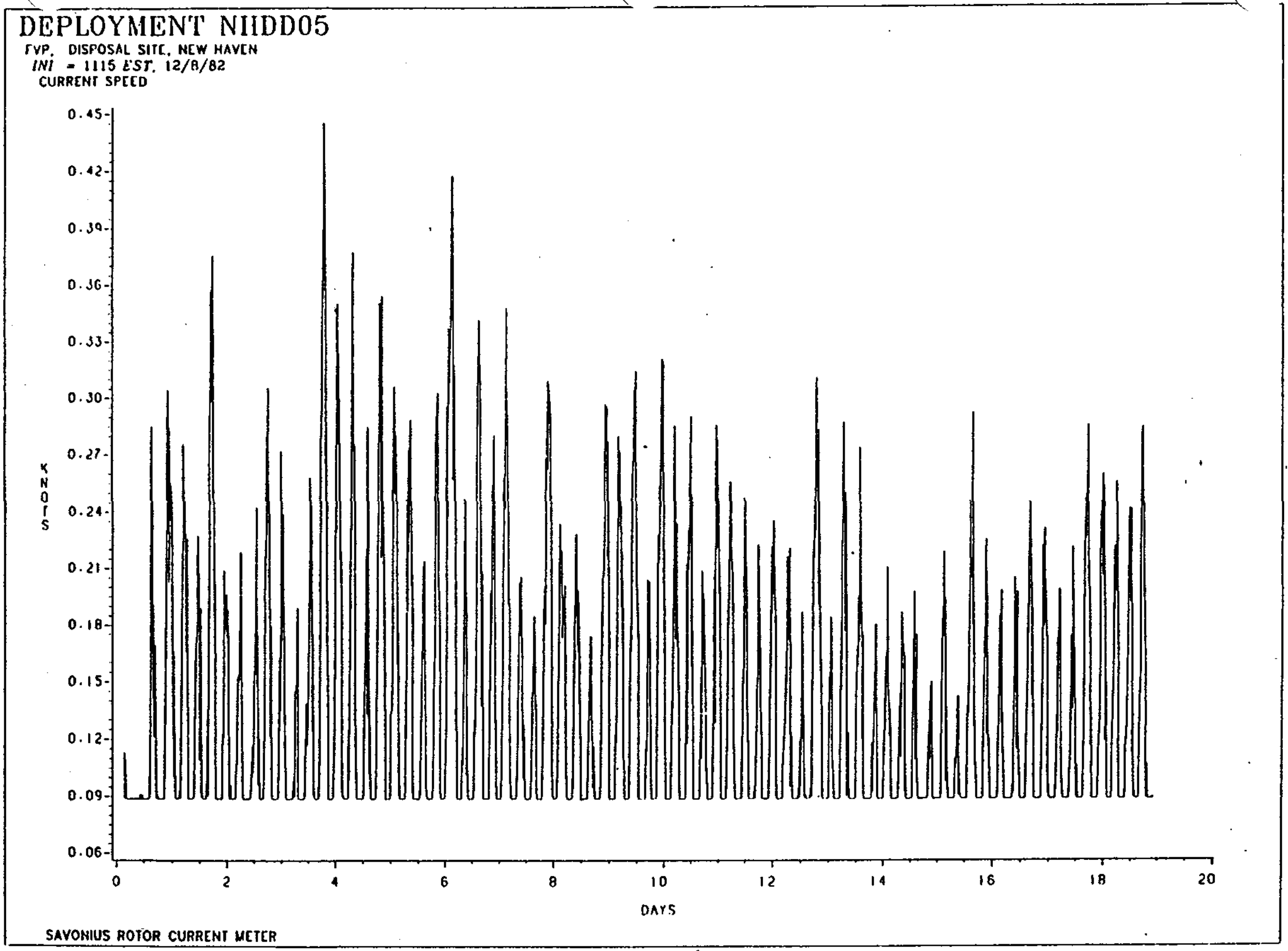

FIGURE III-3-53. Current Speed
Deployment NHDD05

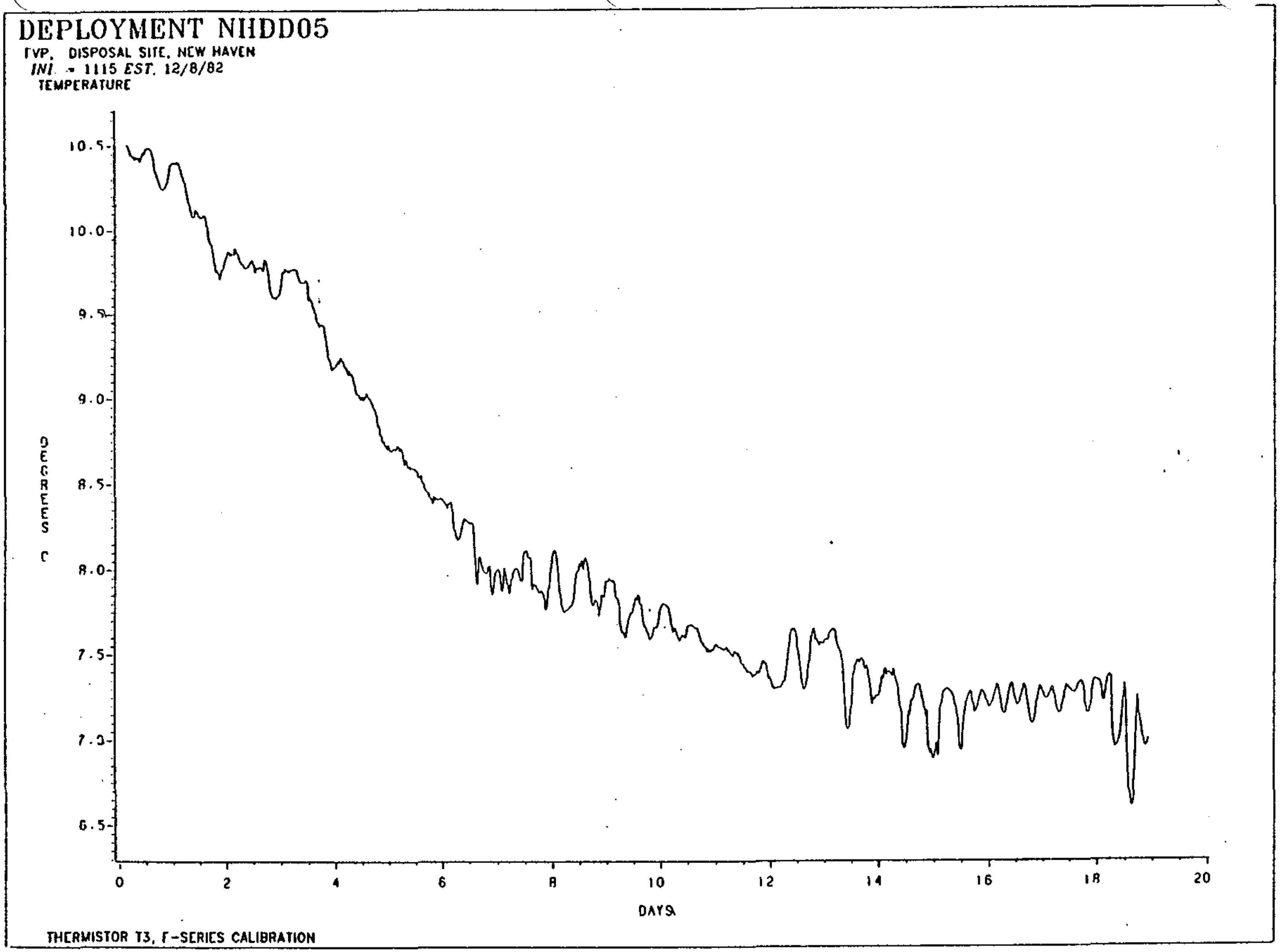

FIGURE III-3-54. Water Temperature - Near Bottom
Deployment NHDD05

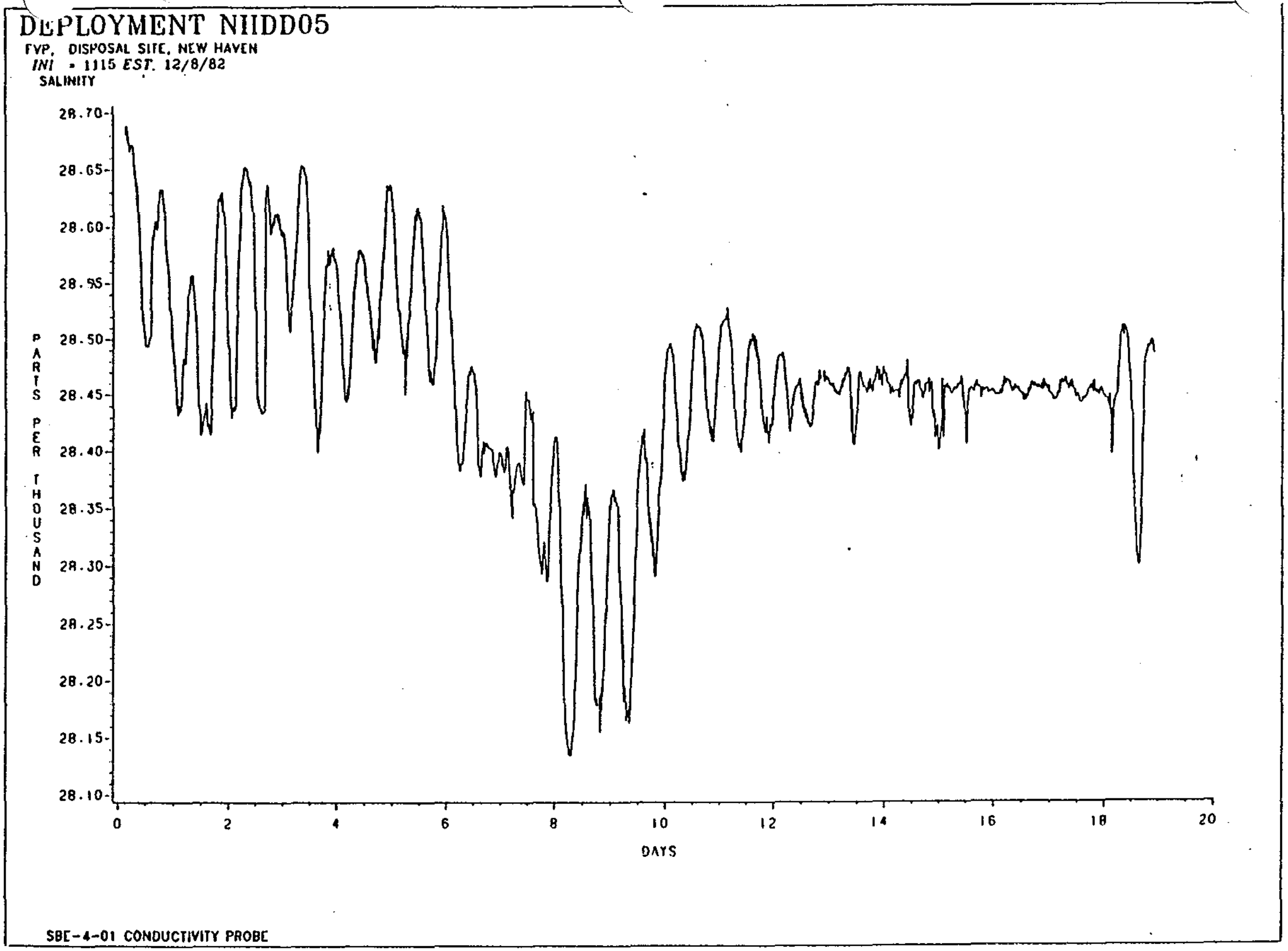

FIGURE III-3-55. Salinity - Near Bottom
Deployment NHDD05

local freshwater streamflows. Alternatively, this perturbation could have been produced by a regional shift in current field characterizing the Central Long Island Sound system induced by a period of intense, persistent wind. Although the period coincident with the observed salinity perturbation was characterized by the above-average winds, generally from the northwest, there is no evidence of a significant alteration in current speed within the savonious rotor record (Fig. III-3-53). Current direction, however, cannot be accurately specified. Since shifts in this latter parameter could alone be sufficient to produce the observed salinity perturbation, inability to accurately detail current direction effectively precludes determination of the cause of the salinity low.

Deployment NHDD06, 27 December 1982 - 25 January 1983

Suspended material concentrations during this period remained relatively constant with values averaging approximately 7.5 mg/l (Fig. III-3-56). On deployment, initial concentrations displayed anomalously low values with concentrations progressively increasing towards the long-term average. This increase persisted for approximately two days before progressively decaying. The cause of this relatively aberrant behavior is unknown and appears to be most probably the result of a variety of factors collectively contributing to unusally low energy conditions within the near-bottom transport field. Review of the available meteorological data from Bridgeport (Appendix III) indicates a prevalence of below-average winds during the period immediately preceeding deployment. Current speeds during this period also appear to be extremely low (Fig. 3-57) on deployment and to progressively increase over Days 1 and 2. This combination appears sufficient to produce initially low suspended material concentrations and to subsequently favor a progressive increase towards the long-term average.

Following the initial increase, average suspended material concentrations remained essentially invariant with peak-to-peak variations correlated simply with the diurnal tidal cycle. Maximum variability occurred during spring tidal conditions (Fig. III-3-57) with concentrations varying by approximately 15 to 30% about the mean. Variability decreased during the neap portion of the tidal cycle with concentrationns varying by something less than ±10% about the mean (Fig. III-3-56).

On several occasions, the regular tidal induced variability is interrupted by short term, large amplitude perturbations. The number of these peaks occurring during this period is significantly less than the numbers observed during the preceding late summer, fall, and early winter deployments. During this December-January deployment, only two significant perturbations were observed. The first, occurring on Day 5 (Fig. III-3-56), appears to be primarily the result of material settlement on the optical windows. The nature of the material, particulate versus large fragments and the like, cannot be simply specified. Given the relatively infrequent appearance of such

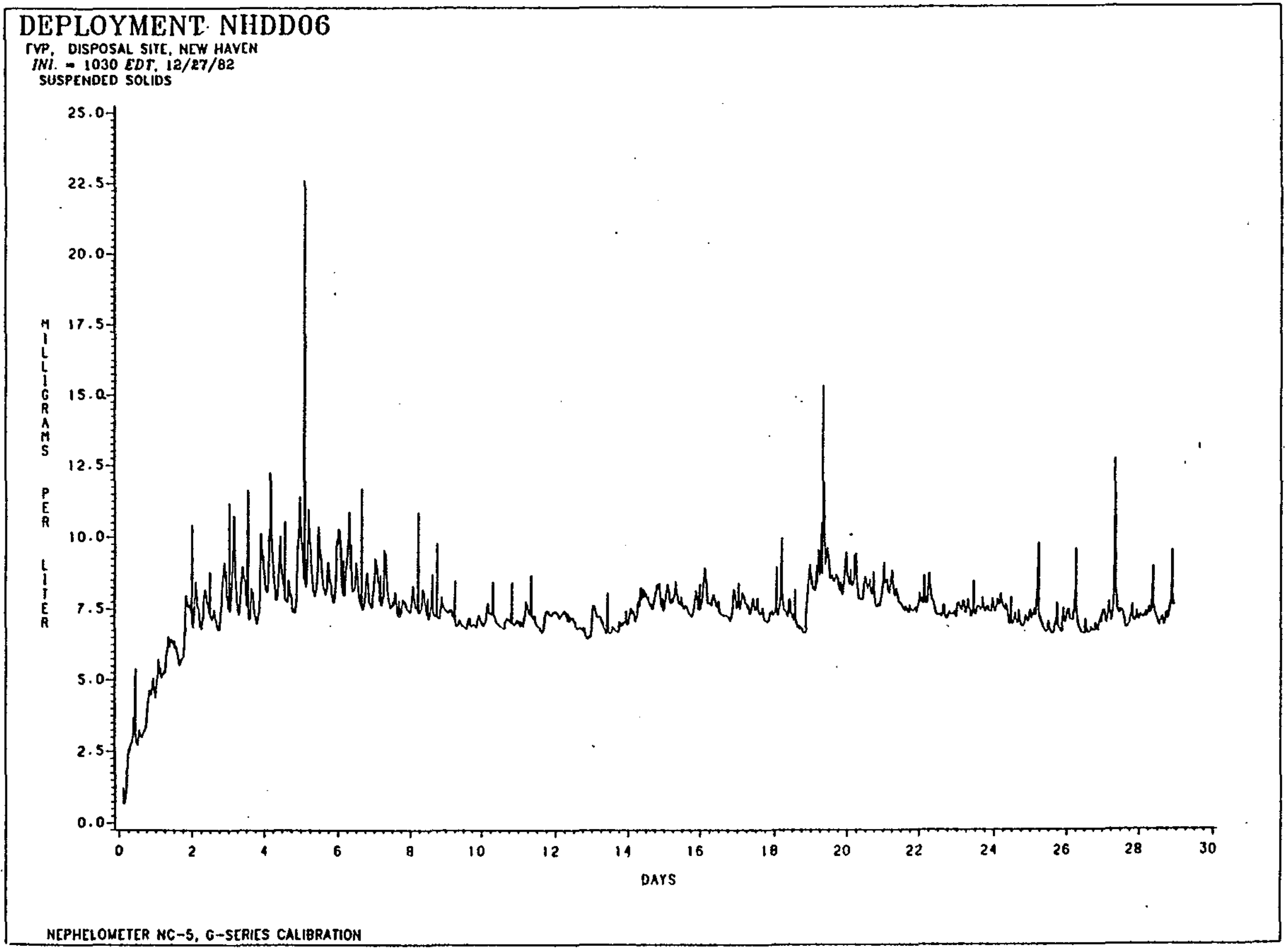

FIGURE III-3-56. Suspended Material Concentrations
Deployment NHDD06

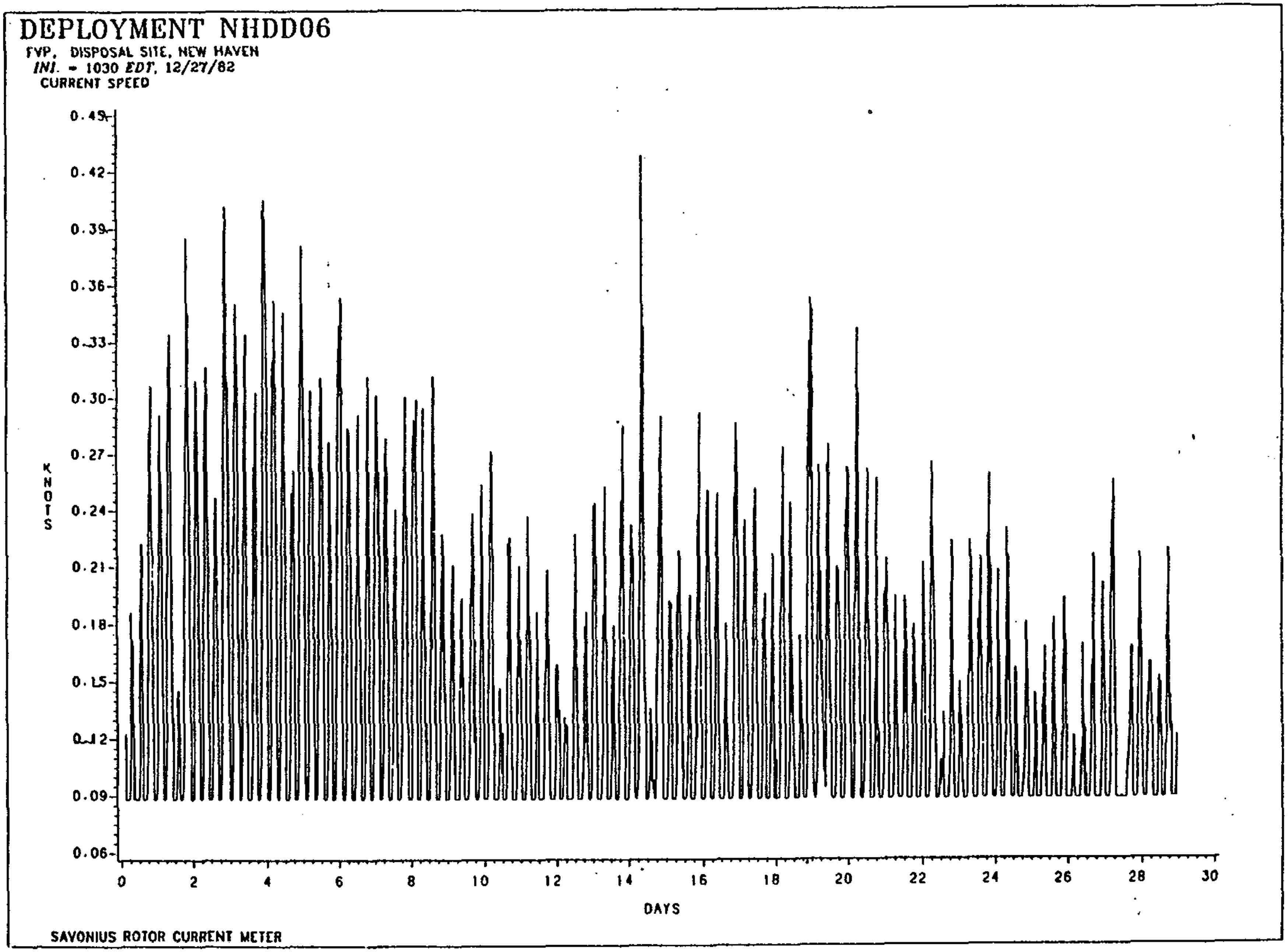

FIGURE III-3-57. Current Speed
Deployment NHDD06

spikes, it appears to be large-fragment induced. The second peak, occurring on Day 19, appears to be the result of storm-induced resuspension of materials from the sediment-water interface. Review of the meteorological data for this period from the Bridgeport National Weather Service station indicates relatively high-velocity easterly winds persisting for approximately 24 hours. Given the orientation of the Sound, such wind directions favor the generation of reasonably large amplitude, low frequency waves sufficient to affect near-bottom shear stress and increase the erosion and resuspension of sediments. The resultant increase in suspended material concentration, as evidenced in the output from the transmissometer, is relatively short-lived and essentially coincident in time with the high-energy wind event. A fraction of the suspended materials appears to have been retained on the optical windows as evidenced by the apparent increase in background concentration following the termination of the wind event. The progressive decay in background appears to be the result of a slow removal or winnowing of these trapped materials by the ambient tidal current and does not appear representative of an actual decrease in concentration levels characterizing the ambient suspended material field.

As in previous months, water temperatures during this deployment period continued to display a steady decrease with values ranging from slightly more than 6.0°C to 2.5°C (Fig. III-3-58). The indicated minimum represents the low temperature cut-off of the sensor circuitry and actual values are expected to be slightly lower with probable minimum between 1 and 2°C. Water temperature variations over this period appear to be primarily the result of tidal factors driving the high frequency variability and the progressive decrease in average air temperature affecting the lower frequency components. The resultant pattern is relatively regular in appearance and displays no significant anomalies.

As in the preceding month, salinity adjacent to the FVP site displayed relatively minor variations over this deployment period with values ranging from a maximum of 29 to minimum of 28°/oo (Fig. III-3-59). The bulk of this variability occurred over a one-to-two day period around Day 23. For the remainder of the time, variability appears dominated by simple tidal cycling resulting in values ranging over less than 0.3°/oo. The cause of this precipitous decrease on Day 23 cannot be simply specified. Reviews of the Bridgeport meteorological data indicate no significant precipitation during this period. The data do, however, indicate relatively high-energy wind conditions for the two-to-three days preceding Day 23 (19 January 1983). These winds, rich in the northwesterly component, appear to have the potential to modify local circulation and, in particular, to favor conditions in which the transport of lower salinity water, most probably from nearshore areas, could be increased at the disposal site. In the absence of detailed data describing both current speed and current direction, this hypothesis cannot be verified.

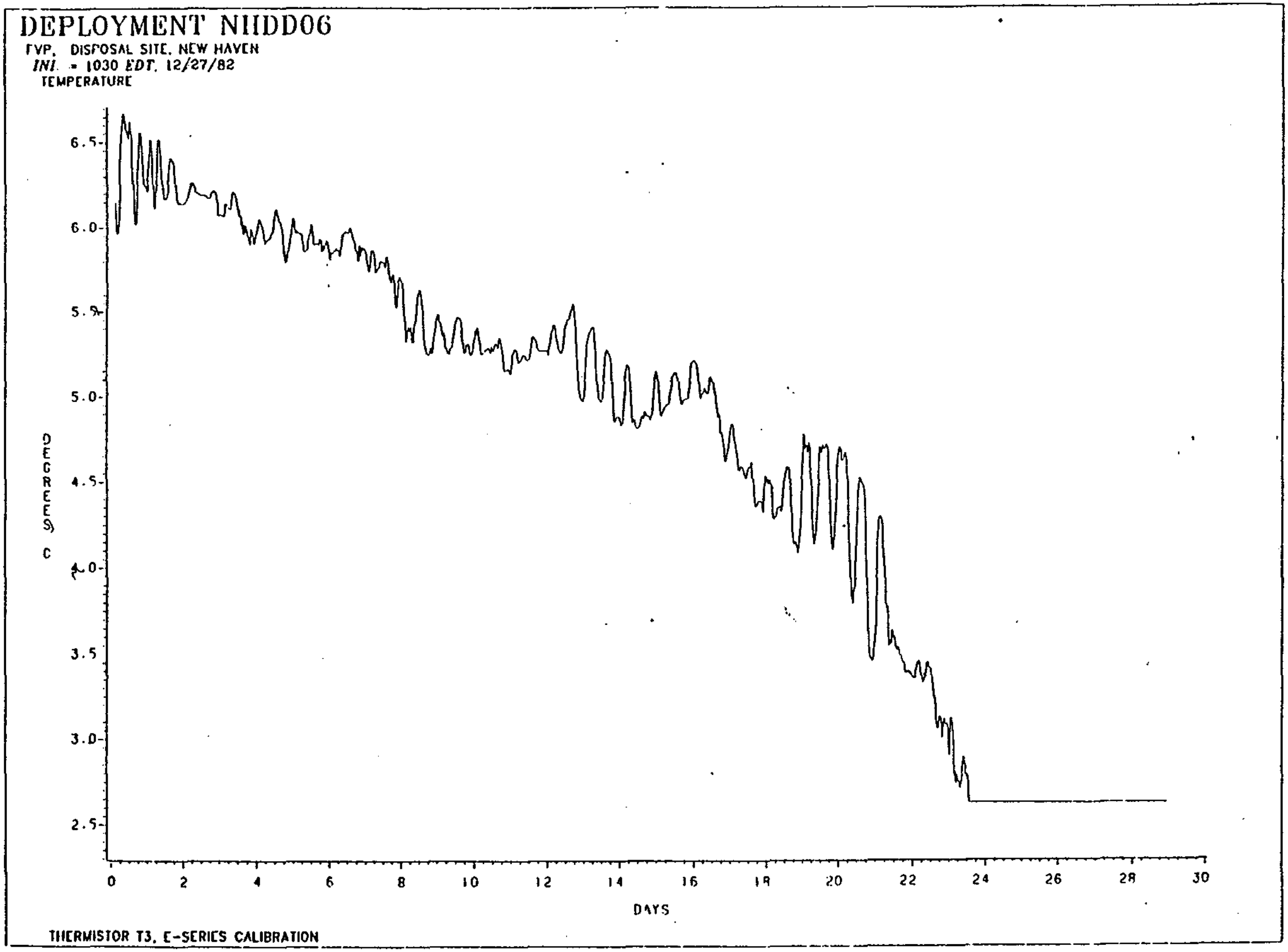

FIGURE III-3-58. Water Temperature - Near Bottom
Deployment NHDD06

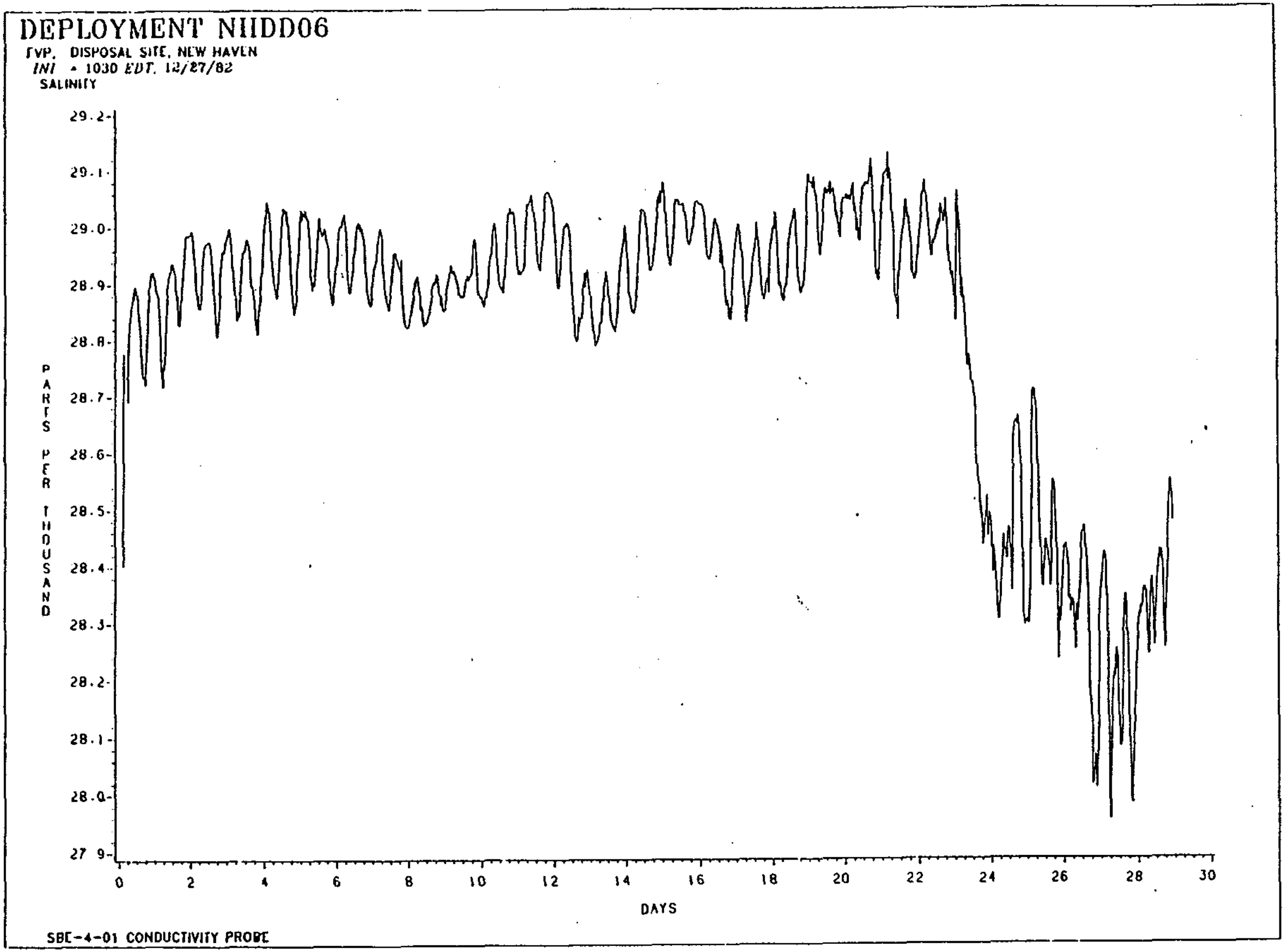

FIGURE III-3-59. Salinity- Near Bottom
Deployment NHDD06

Current speeds over the deployment period (Fig. III-3-57) display a regular variability in response primarily to local tidal conditions. In addition to this variability, however, the effects of the high-energy wind event on Day 19 also appear within the record. For a period of approximately one-half a day, current speed increases to levels well in excess of those prevailing both immediately before and immediately after the event. This increase appears to be the result of a wave-induced alteration within the near-bottom velocity field. The magnitude of this alteration is unknown, however, since the response provided by the savonius rotor is basically insensitive to the directional, oscillatory sense of the wave-induced velocity. As a result, the unit simply "spins-up" providing an indicated velocity that is substantially higher than the actual velocities affecting the sediment-water interface. In the absence of concurrent wave observations sufficient to permit decomposition of the velocity record into its component parts, the savonius data can only be used as an indication of the presence of wave-induced velocities and cannot be used to provide an indication of their magnitude.

Deployment NHDA07, 27 January - 14 March 1983

Suspended material concentrations during this deployment displayed relatively minor variations with average concentrations remaining essentially constant at approximately 8 mg/l throughout the period (Fig. III-3-60). High frequency variability was dominated by the local tidal system with maximum variability occurring during the spring tidal phase. The apparent increase in indicated background level and associated degree of variability after Day 28 appear to be the result of increased biological activity both through direct fouling of the optical sensors and increasing water column activity due to phytoplankton blooms. Visual inspection of the array following recovery suggests only that both elements are present and contribute significantly to a blockage of the light path. Such conditions appear to continue to prevail during much of the remainder of the winter and early spring.

Water temperature during this period reached its annual minimum of approximately 1.5^{o}C and began a progressive increase reaching 2.8^{o}C by Day 36 (Fig. III-3-61). This monthly pattern displayed minimal aberrant behavior and is characterized by high frequency variability coincident with local tidal characteristics and a lower frequency trend that appears to be reasonably coincident with the air temperature patterns observed at Bridgeport. Such behavior appears quite regular and predictable.

Near-bottom salinity during the immediate post-deployment period displayed a regular variability, apparently coincident with the dominant semi-diurnal tide. Average values over this four-to-five day period remained essentially invariant at 28.2^{o}/oo. Following a slight rise on Day 8, values decreased rapidly in two rather abrupt steps to approximately 27.9^{o}/oo on Day 14 (Fig. III-3-62). Beyond this

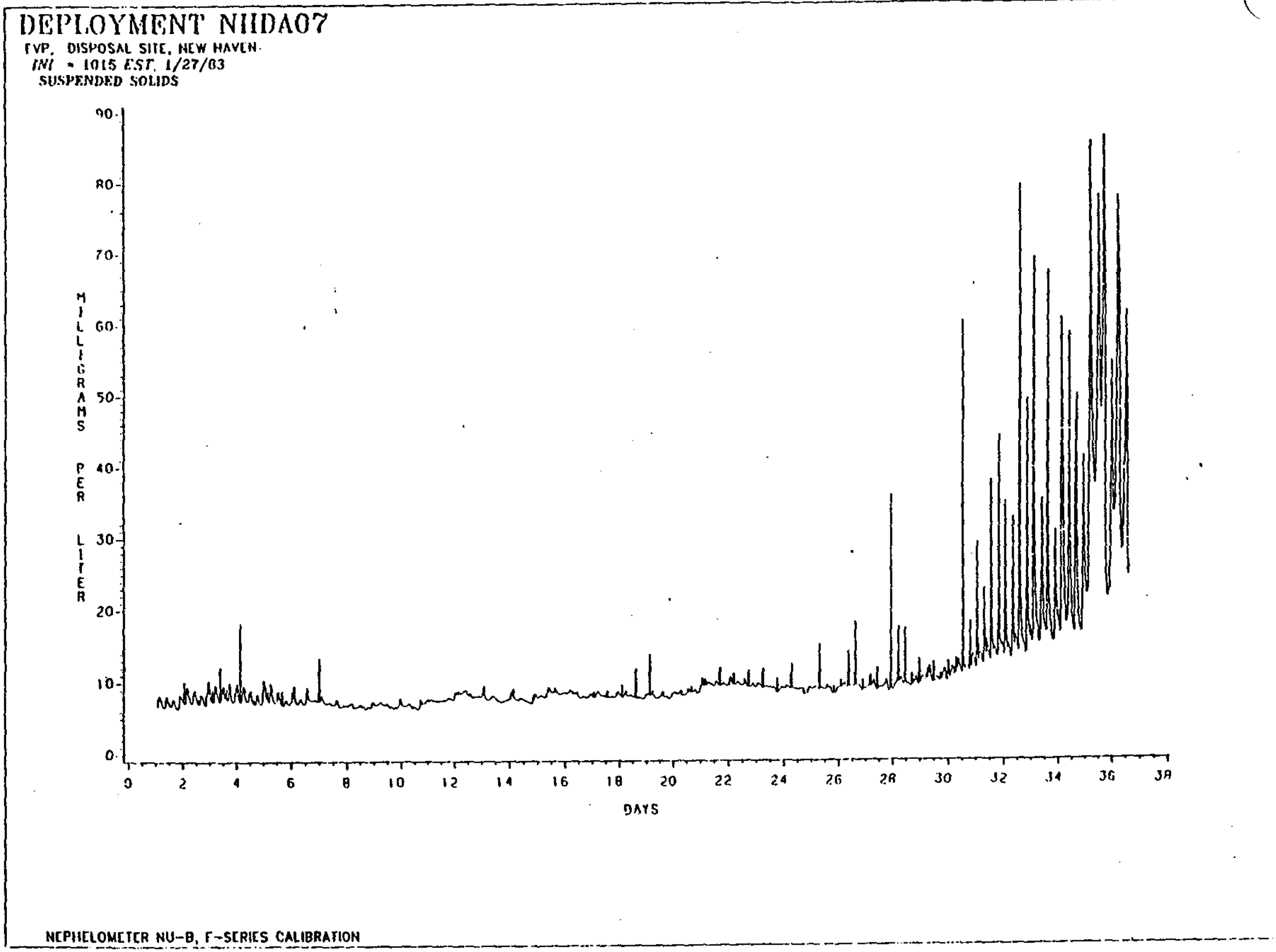

FIGURE III-3-60. Suspended Material Concentrations Deployment NHDA07

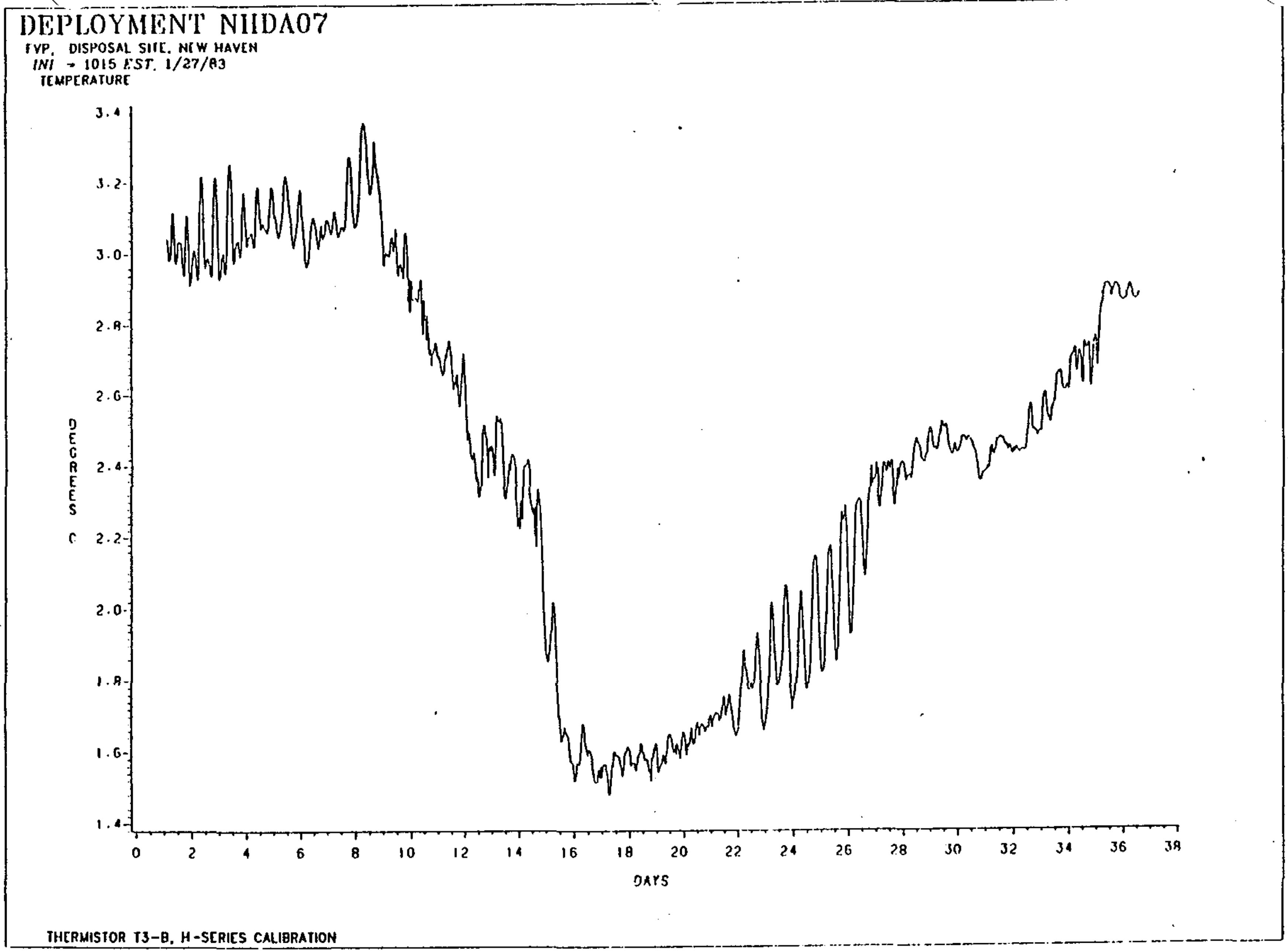

FIGURE III-3-61. Water Temperature - Near Bottom
Deployment NHDA07

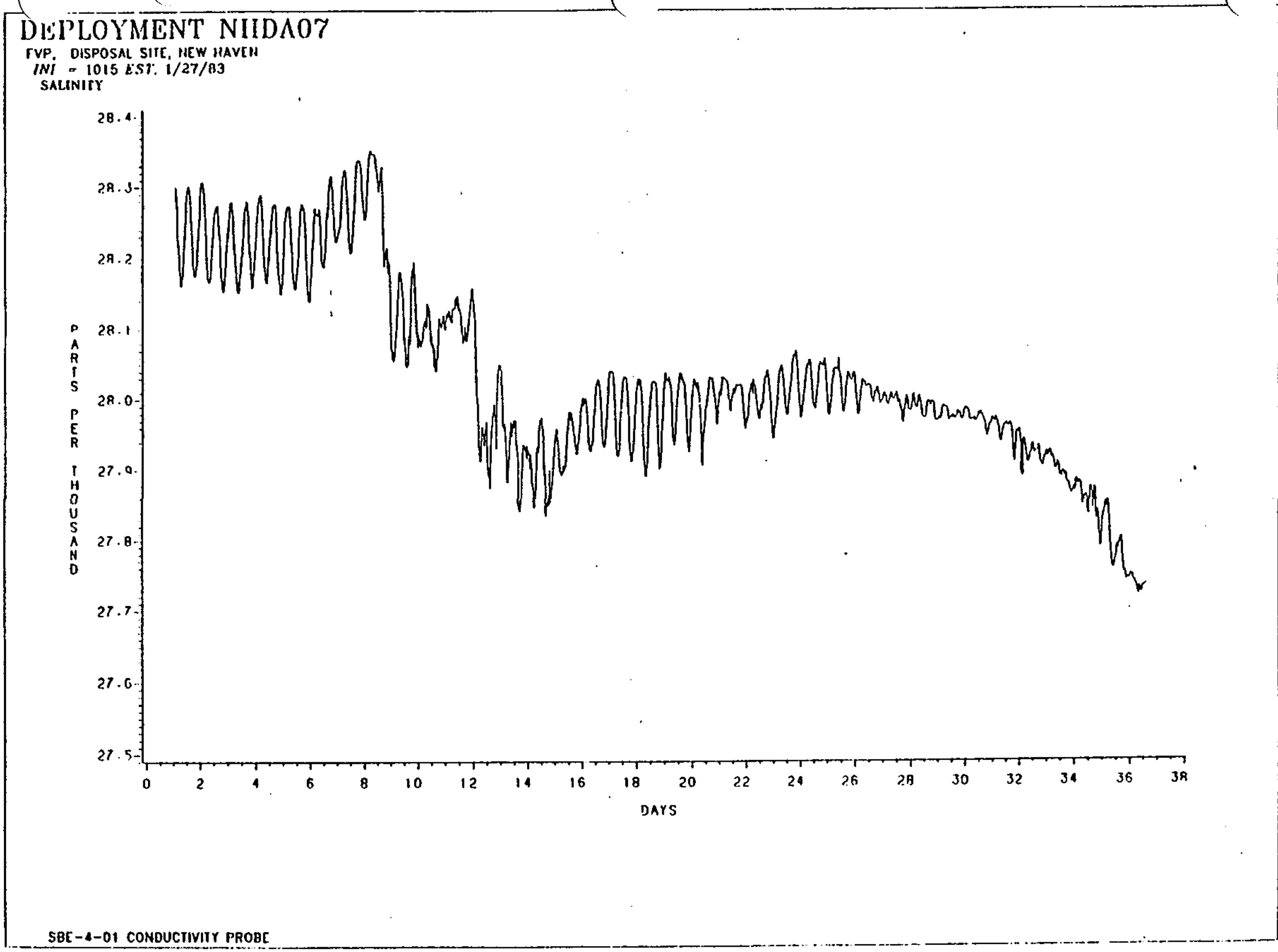

FIGURE III-3-62. Salinity - Near Bottom
Deployment NHDA07

point, average values again remained near-constant with deviations dominated by the tidal cycle. Such conditions prevailed through Day 26, when a slow but persistent decrease in average values set in. The cause of the stepwise and then more linear decrease in salinity is unknown. Review of the meteorological data from the Bridgeport station suggests that the gradual decrease in salinity beyond Day 26 is the result of a regionwide increase in streamflow due to a six day period of relatively intense rainfall in early March 1983. For the period preceding the stepwise decreases around Day 8, no such simple correlation appears and the perturbations are presumed to be most probably the result of a combination of rainfall-runoff and wind-induced alterations in local circulation. Again, this hypothesis cannot be simply verified or tested.

Current speeds for the deployment period displayed variability dominated by semi-diurnal and semi-monthly tidal cycling (Fig. III-3-63). The record for this period was essentially free of significant non-tidal perturbations and appeared to be generally consistent with the available wind data from Bridgeport.

<u>Deployment NHDD08, 14 March - 8 April 1983</u>

The progressive increase in suspended material concentrations evident within the transmissometer data towards the end of the preceding deployment (Fig. III-3-60) continued during this deployment, causing a progressive increase in background concentration ranging from 10 mg/l to greater than 20 mg/l (Fig. III-3-64). The associated accumulations of material on the windows of the optical sensor effectively inhibited light transmission after Day 10. This accumulation appears to be primarily the result of materials settling from the water column rather than deposition of sediments resuspended from the sediment-water interface. Such resuspension requires an increase in transport energy. Review of the meteorological data provides no indication of significant wind events or associated rainfall-runoff during the early stages of this deployment period. As a result, the indicated increases in light attenuation must be presumed to be primarily due to deposition of materials settling from the water column in combination with some additional direct fouling of the optical windows. This latter growth, however, generally requires ten to fourteen days of exposure prior to a significant set. The rapid increase in light attenuation immediately following deployment of the instrument array suggests, therefore, that fouling consitutes a relatively small contribution compared to particulate settling. Visual inspection following recovery of the array indicated only minor fouling and tends to support this construct.

Water temperatures during this deployment continued to display a clear increase in average value, ranging from 2.8°C immediately post-deployment to approximately 4.5°C by Day 24 (Fig. 3-65). The increase was reasonably uniform over this period, with significant decreases confined to a single four-day

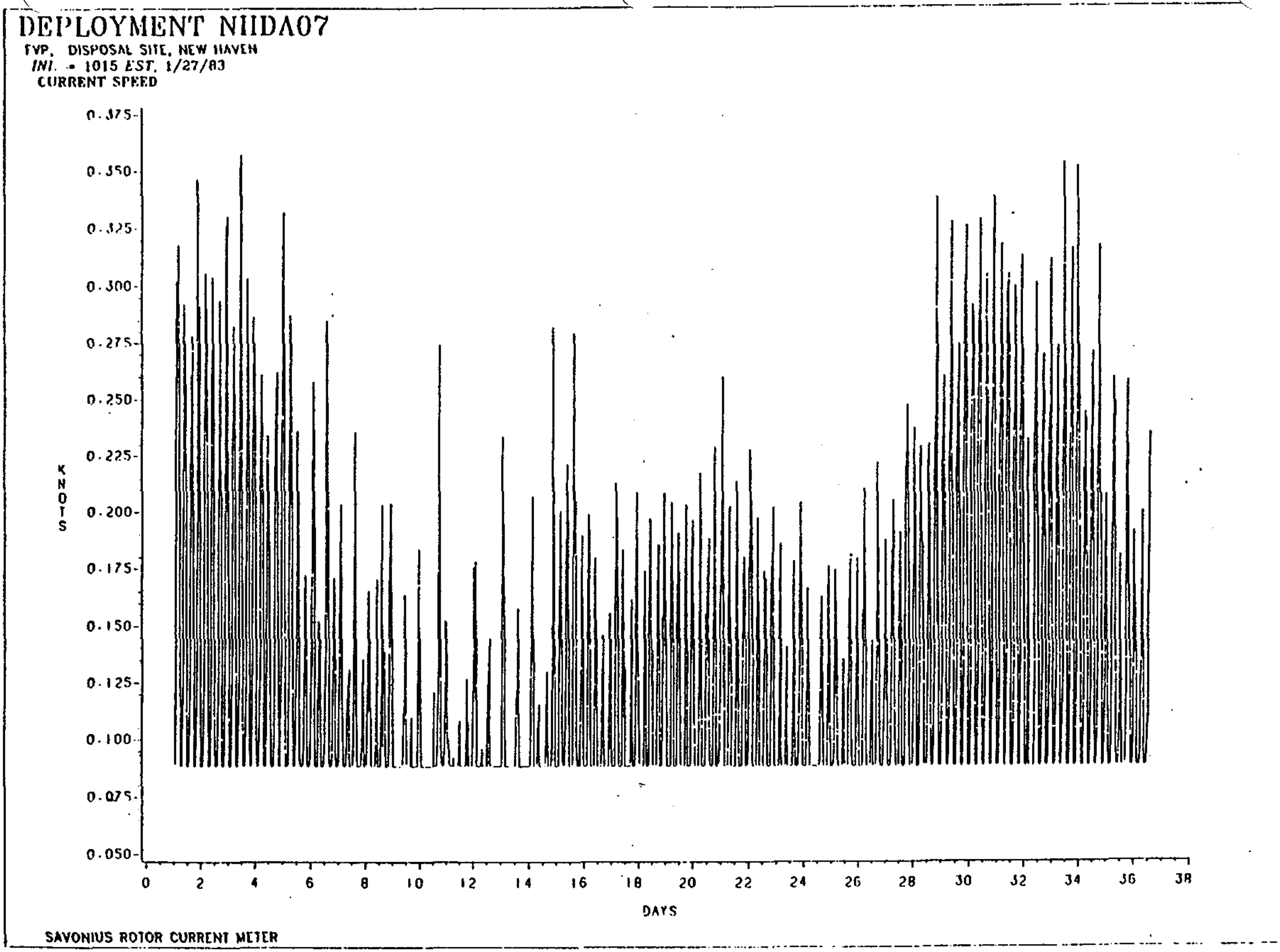

FIGURE III-3-63. Current Speed
Deployment NHDA07

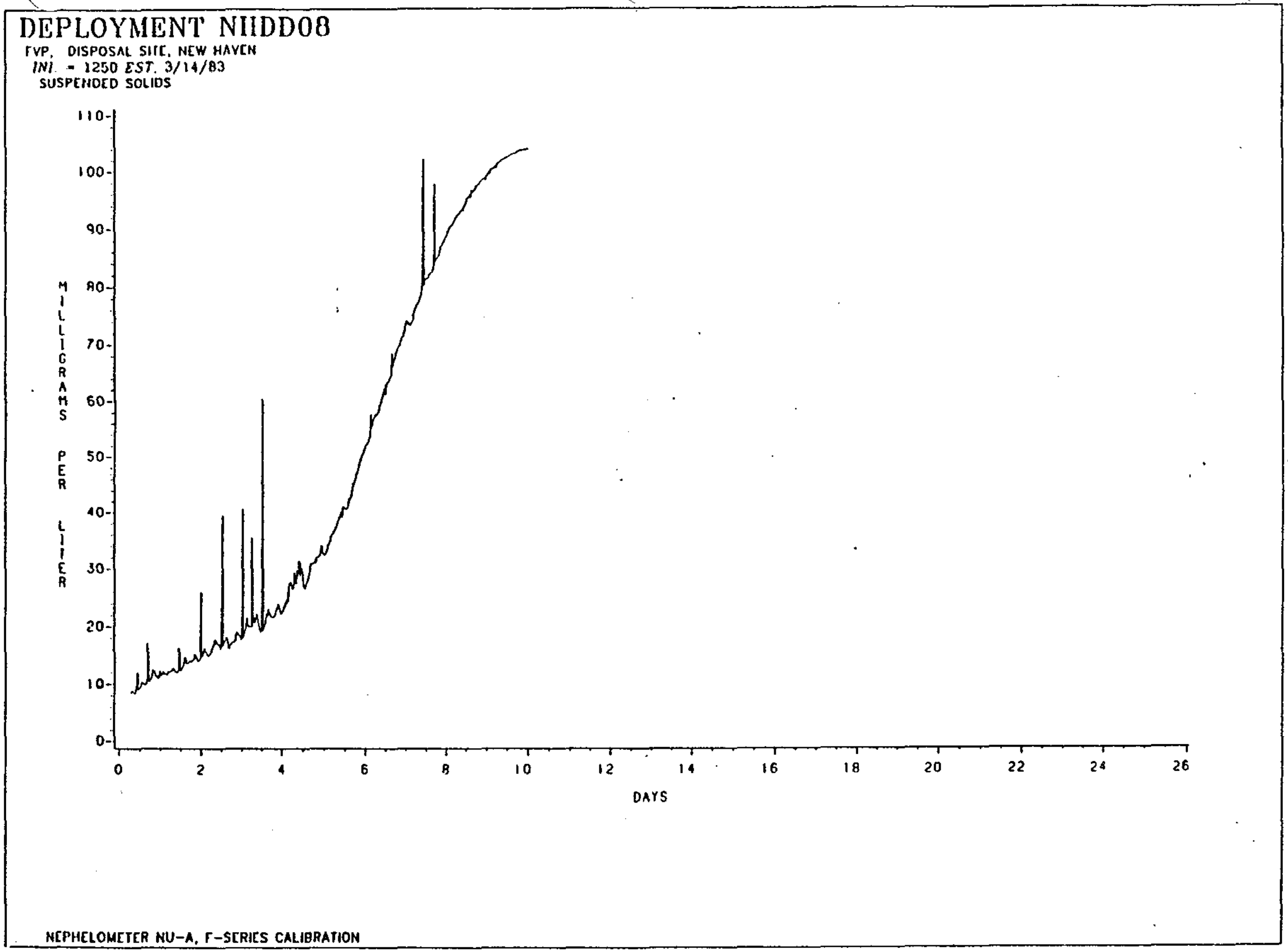

FIGURE III-3-64. Suspended Material Concentrations
Deployment NHDD08

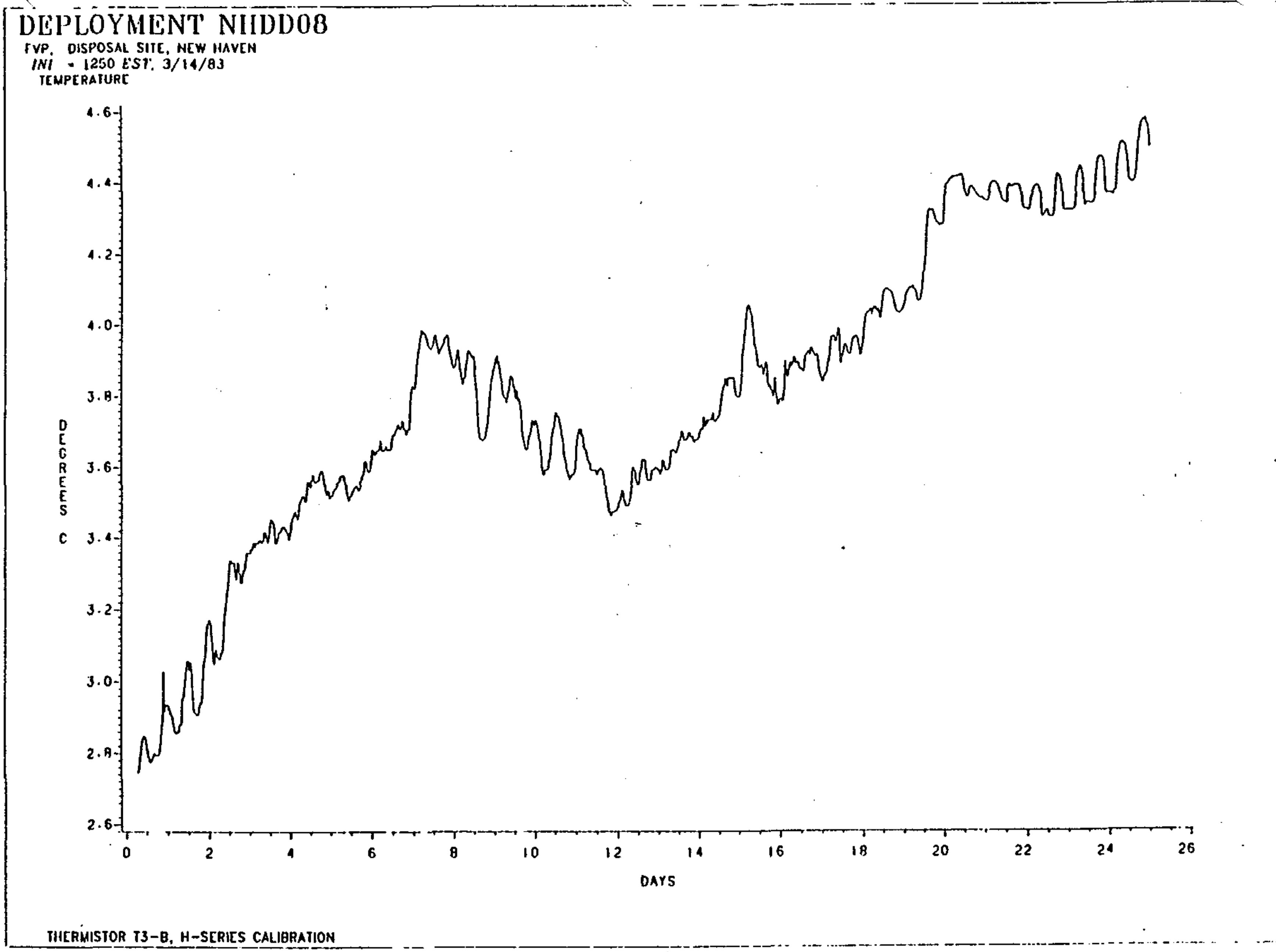

FIGURE III-3-65. Water Temperature - Near Bottom
Deployment NHDD08

interval following Day 7. This retreat appears to be reasonably well-correlated with concurrent air temperatures at Bridgeport (Appendix III), which over this period displayed values that ranged from 3 to 10°C below normal and resulted in monthly low temperatures. With the exception of this deviation, the remainder of the variability characterizing the temperature record appears simply dominated by the local tidal system and in particular, the dominant semi-diurnal components.

Salinity during this period displayed an essentially linear decrease with values falling from 27.5°/oo on deployment to 26.4°/oo by Day 24 (Fig. III-3-66). This decrease is correlated with the seasonal increase in freshwater discharge to the Sound, with higher frequency perturbations associated with tidal forcing, and aperiodic variations in mean circulation, most probably associated with regional wind patterns. This latter factor appears to have been relatively insignificant during this deployment period wih the exception of a single event during Day 20. This event, characterized by a wind system rich in easterly components, produced an obvious perturbation in near-bottom current speed (Fig. III-3-67) most probably through surface wave-induced velocities. Unfortunately, the effects of this perturbation on the ambient suspended material field cannot be demonstrated.

Deployment NHDB09, 18 April - 26 April 1983

Suspended material concentrations during this deployment displayed a progressive increase from approximately 4 mg/l at the start of the sampling period to slightly more than 13 mg/l on Day 8 (Fig. III-3-68). Associated with this low frequency variability, and impressed upon it, were high frequency variations with periods approximately similar to the M2 tidal components. Suspended material concentrations during these perturbations varied by approximately ±20% about the short-term mean. Visual comparisons indicate increasing near-bottom concentrations during both periods of increasing and decreasing current speed (Fig. III-3-69 and III-3-70). Such behavior appears representative of a system in which materials are alternately moved upward and away from the sediment-water interface by increasing velocities and downward, or toward the boundary, as the velocity decreases. This alternate resuspension and settling suggests that the near-bottom suspended material field adjacent to the FVP site is dominated during this period by a persistent assemblage of fine grained materials, or "fluff layer". The relative importance of the water column versus the sediment-water interface as a source of materials to this layer cannot be specified and there is some suggestion that the presence of the layer serves to effectively armor the major portion of the sediment column lying below the immediate interface.

The progressive increase in output level from the optical sensor apparent in Figure III-3-68 appears representative of an associated increase in average suspended material

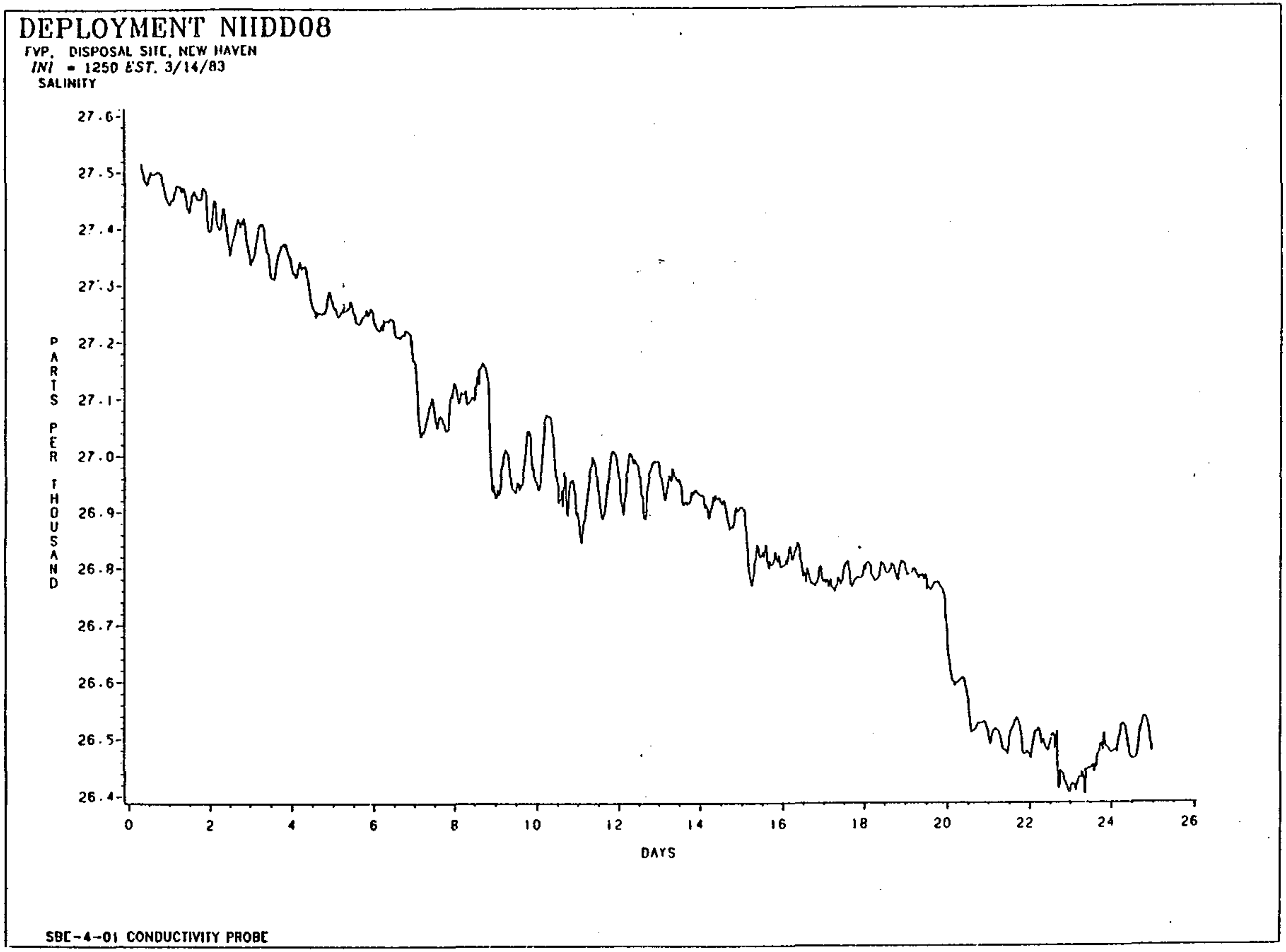

FIGURE III-3-66. Salinity - Near Bottom
Deployment NHDD08

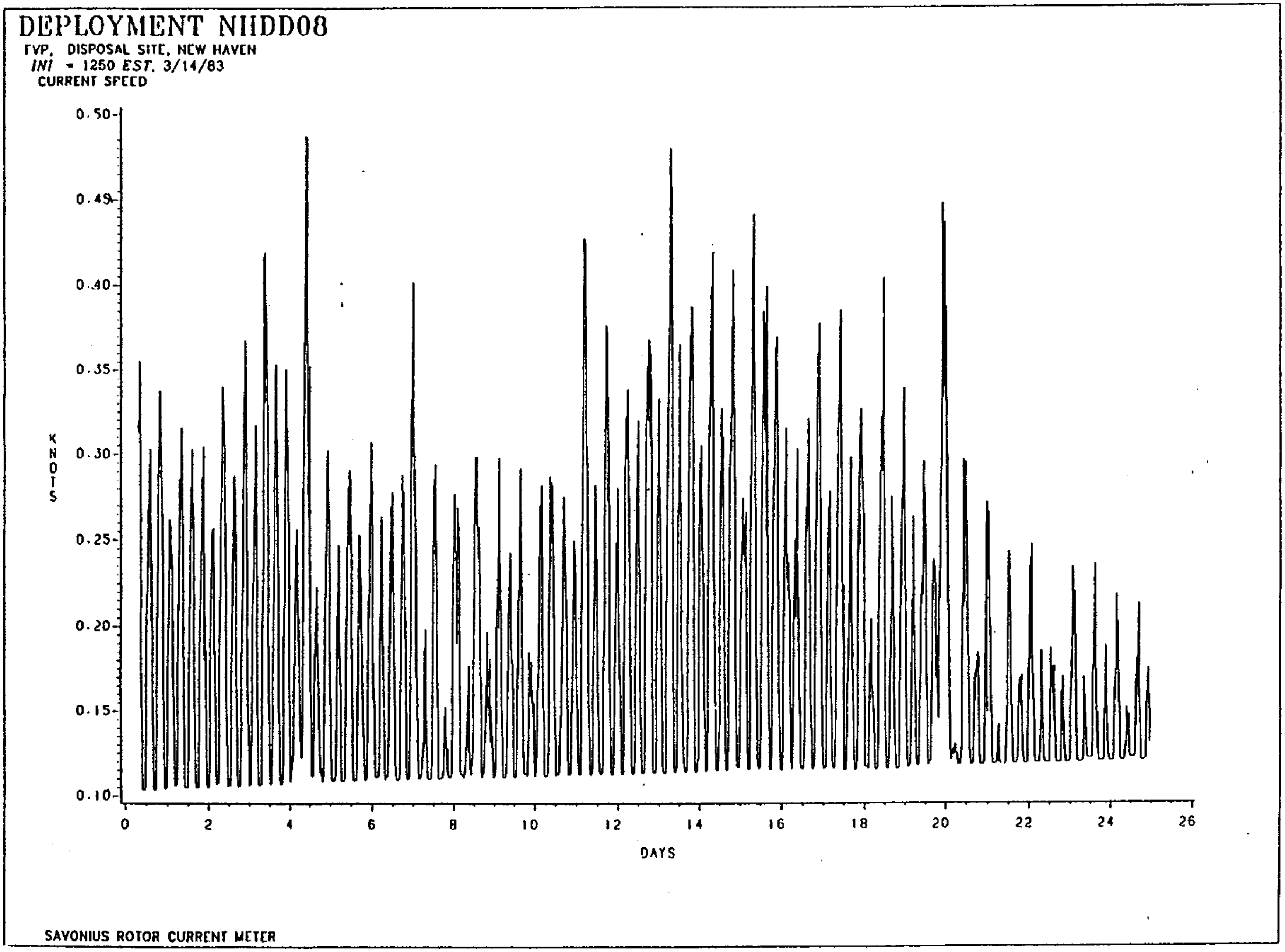

FIGURE III-3-67. Current Speed
Deployment NHDD08

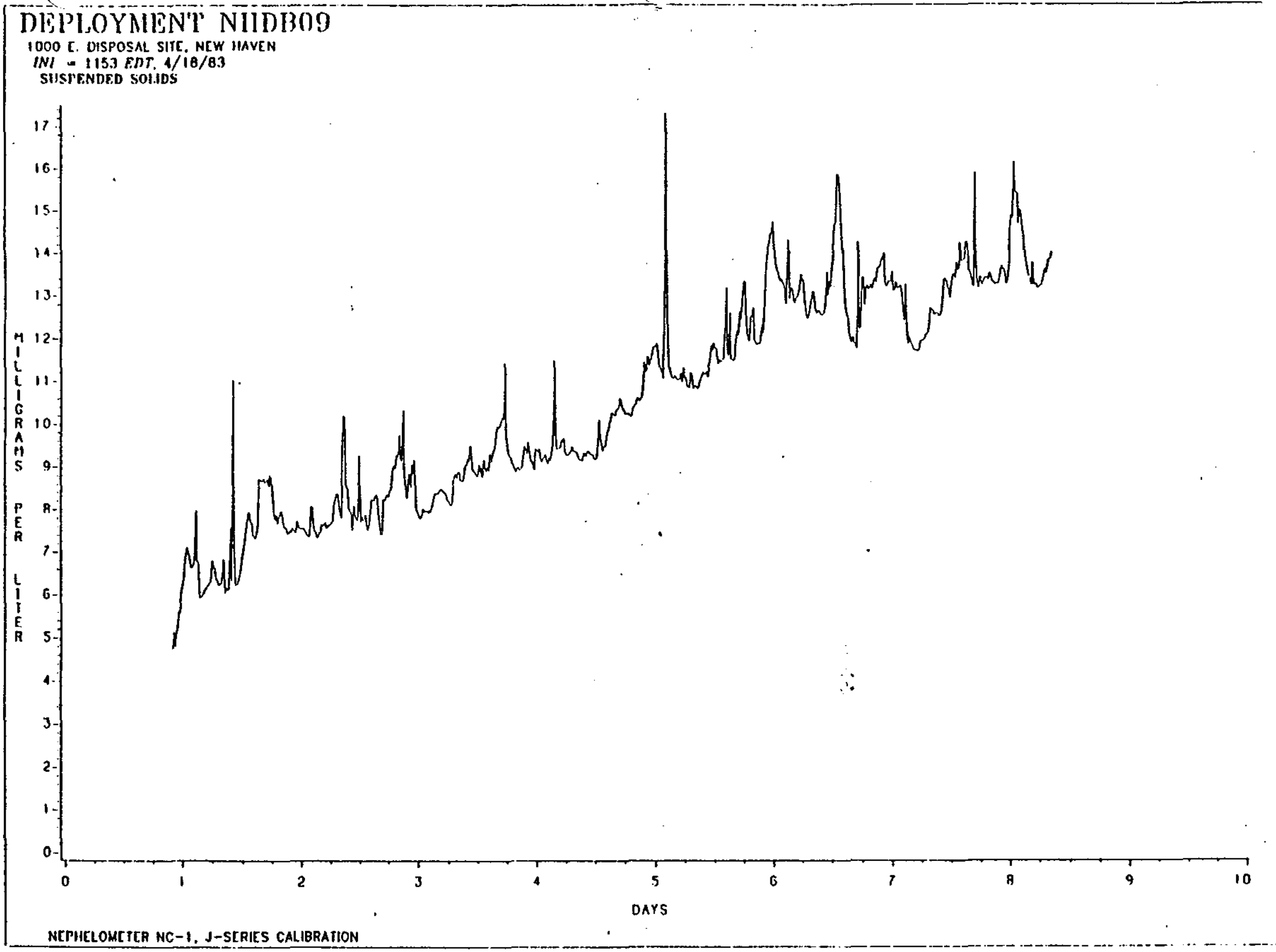

FIGURE III-3-68. Suspended Material Concentrations
Deployment NHDB09

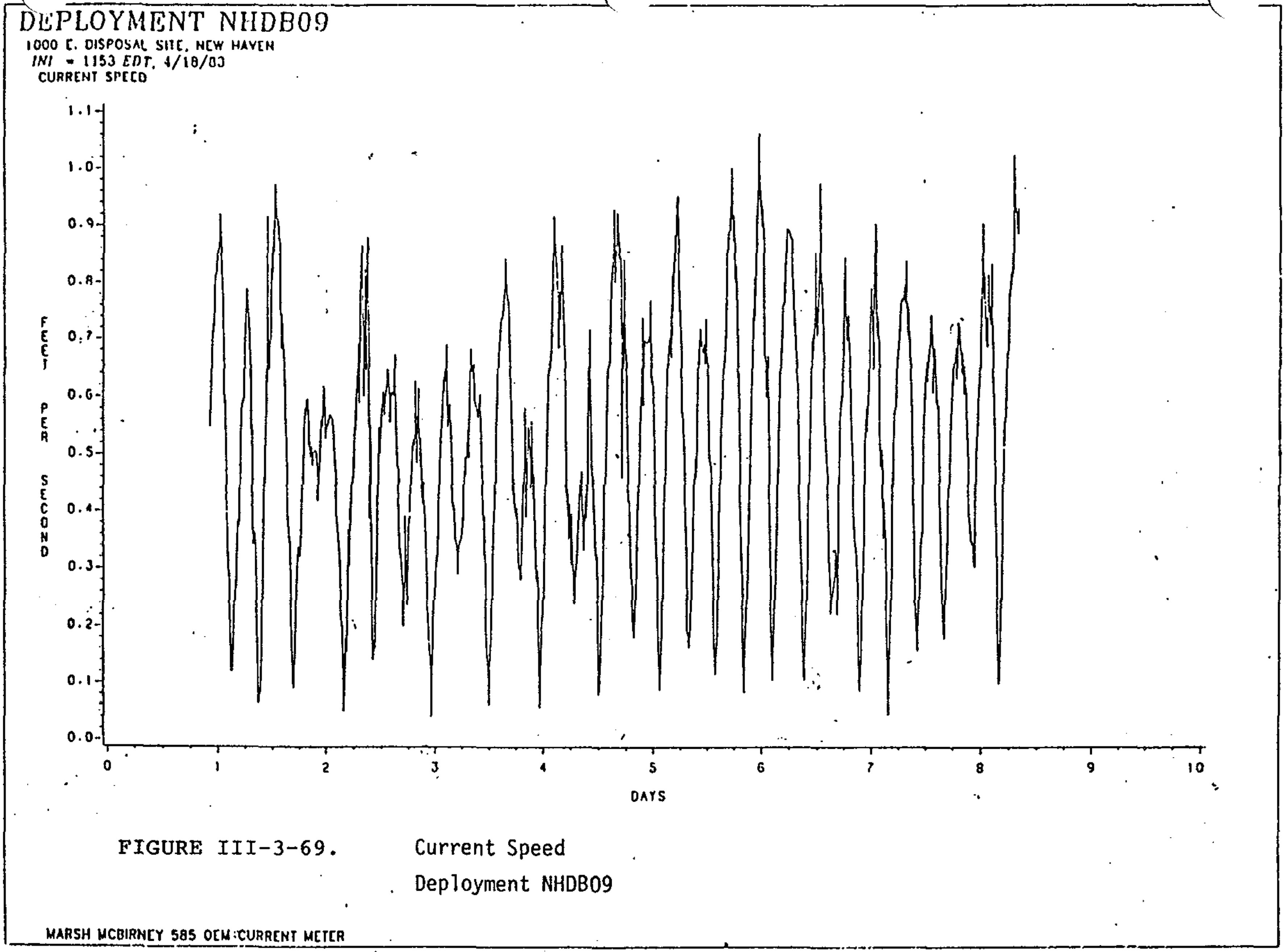

FIGURE III-3-69. Current Speed
Deployment NHDB09

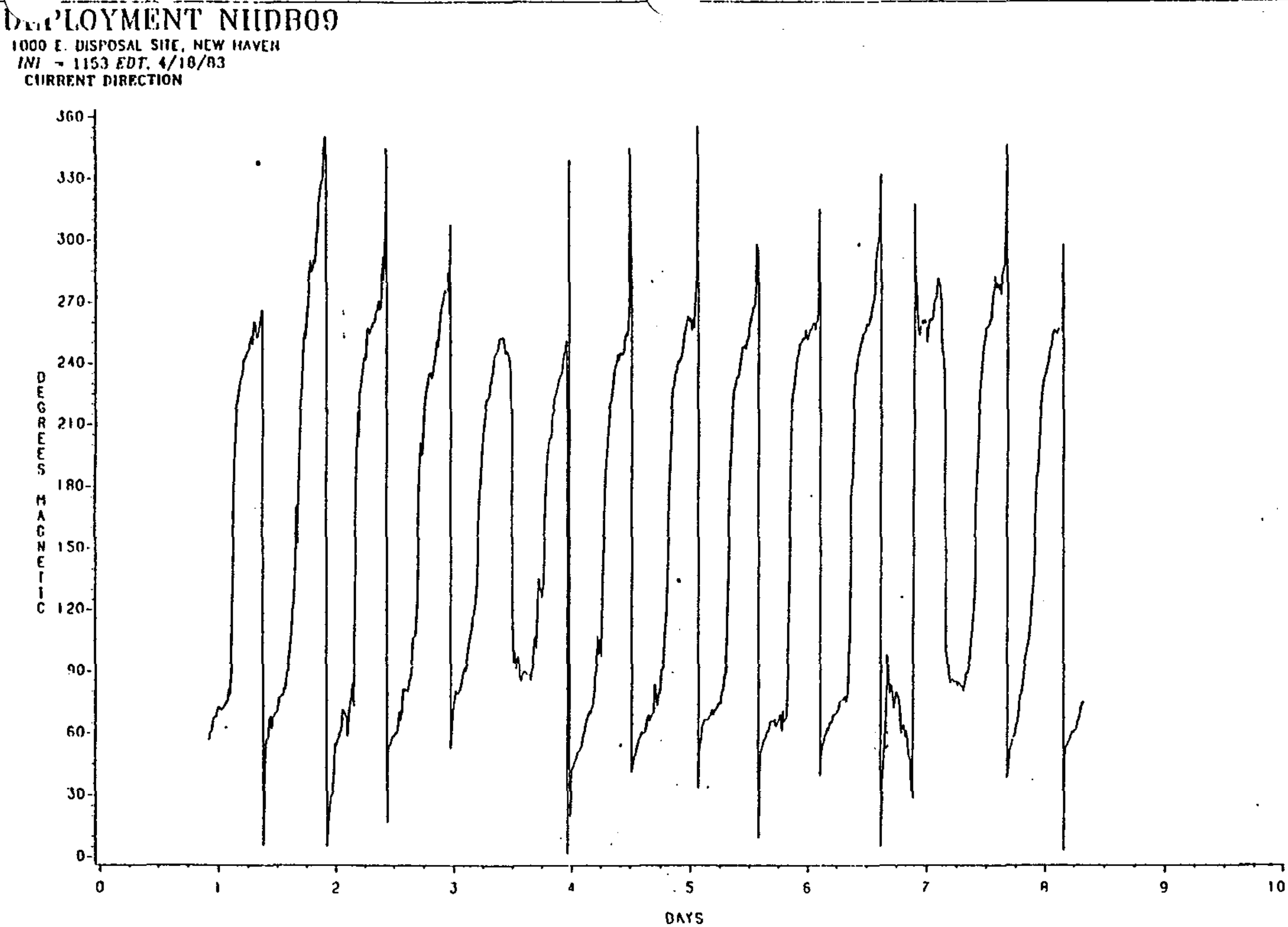

FIGURE III-3-70. Current Direction
Deployment NHDB09

MARSH MCBIRNEY 585 OEM CURRENT METER

concentration. As previously discussed, increases in sensor output produced by biological fouling of the optical windows, or by simple accumulations of sediment within the sampling volume, tends to result in a characteristic signature within the output signal dominated by variability sufficiently large to obscure typical tidal variability and similar natural perturbations. The observed output does not display these characteristics and, despite the increase in average concentration levels, perturbations associated with the tidal cycle are evident throughout the deployment record. In addtion to the absence of this characteristic signature, the duration of the deployment period is short compared to the times normally required to permit significant biological fouling. This combination of factors suggests that the observed increase in sensor output is not a sampling-related artifact, but rather is representative of a progressive increase in background suspended material concentrations.

The cause for the observed increase in near-bottom suspended material concentrations cannot be specified and is most probably the result of a variety of factors, including increased biological activity (particularly infaunal), storm-induced resuspension associated with wind stress events, and increased supplies of river-borne sedimentary materials. Of these factors, variations associated with the latter river-borne supplies appear to represent the most probable cause of the observed increase in background concentrations. Within the Central Long Island Sound area, benthic biological activity can serve to modify the stability of the sediment-water interface. The effects of such activity, however, is generally confined to the immediate vicinity of the sediment-water interface, and is evidenced by an increase in the characteristic variations about the mean rather than an increase in the mean itself. A substantive increase in the mean requires a larger volume of sediment than is normally associated with benthic biological activity.

Storm activity has the potential to significantly modify concentrations associated with the suspended material field throughout Long Island Sound. Such perturbations, however, are typically short-lived and essentially confined to the period of storm passage. In addition to this factor, review of the meteorological records obtained by the U.S. National Weather Service station in Bridgeport, Connecticut, indicate that no significant storms occurred during this deployment period (Appendix III). This suggests that the observed variations in background suspended material concentrations were most probably the result of an increase in river-borne sediment supplies entering the Western and Central Sound.

To the west of the Connecticut River, the primary source of freshwater to Long Island Sound, freshwater and the associated supply of suspended material enter the Sound via discharge from the Housatonic, Mill and Quinnipiac Rivers. Of these sources, the Housatonic represents the dominant supply, with an annual average discharge of approximately 2,600 ft^3/sec. During early April 1983, streamflow from the

Housatonic began a progressive increase, with discharge going from approximately 6,500 ft^3/sec on 1 April to 13,000 ft^3/sec by 18 April. Over the deployment period, this increase continued with values reaching a maximum of 19,800 ft^3/sec on 20 April and remaining high through 28 April before beginning a progressive decrease towards the annual average values.

The effects of the progressive increase in freshwater discharge during April 1984 on the hydrography of the Western Sound is reflected in part in the observed near-bottom salinity distribution with, after some initial variations, values displaying a persistent decrease from approximately 26.5 ^{o}/oo on 22 April to 25.8 ^{o}/oo by the end of the deployment period (Fig. III-3-71). Concurrent water temperatures display a more variable pattern and appear to be associated primarily with prevailing air temperatures rather than streamflows (Fig. III-3-72). Available meteorological data indicate that the air temperatures throughout the deployment period were substantially below the values expected for this time of the year (Appendix III). Given these characteristics, the observed increase in suspended material concentrations can only be correlated with regional streamflow.

To summarize the pre-disposal period, the time series observations from August 1982 through mid-April 1983 show the suspended material field in the vicinity of the FVP site to be a reasonably coherent system with a relatively well-defined and predictable range of variability. Throughout the observation period, the average material concentration levels equalled approximately 7.5 mg/l with a regular variability over the dominant semi-diurnal tidal cycle of $\pm$10-15%. This regular variation appeared to be primarily the result of alternate resuspension and settling of an assemblage of organic and inorganic materials from the vicinity of the sediment-water interface. During the biologically active months, generally the non-winter period, the materials present in this near-bottom layer are supplemented by varying fractions of materials from the adjacent water column. These particulate materials appear to be primarily organic in nature with inorganic, river-borne, sediments representing a relatively minor, generally negligible, fraction. This seasonal variation in the source of the materials constituting the total suspended material field produces some variations in the response of the system, as evidenced by variations in the signature of the signal output from the optical sensors employed on the instrumentation array. In particular, increasing fractions of materials supplied via water column production and ultimate settling results in increased long-term accumulations of materials within the sampling volume of the optical sensors. This accumulation, in turn, results in a progressive increase in light attenuation and an associated increase in sensor output indicative of increasing suspended material concentrations. In combination with direct biological fouling of the optical windows, this instrument artifact limits the utility of the optical sensors during periods of intense biological activity to less than 12 days before cleaning is required. In contrast to this progressive degradation in signal quality during biologically active periods, materials settling on

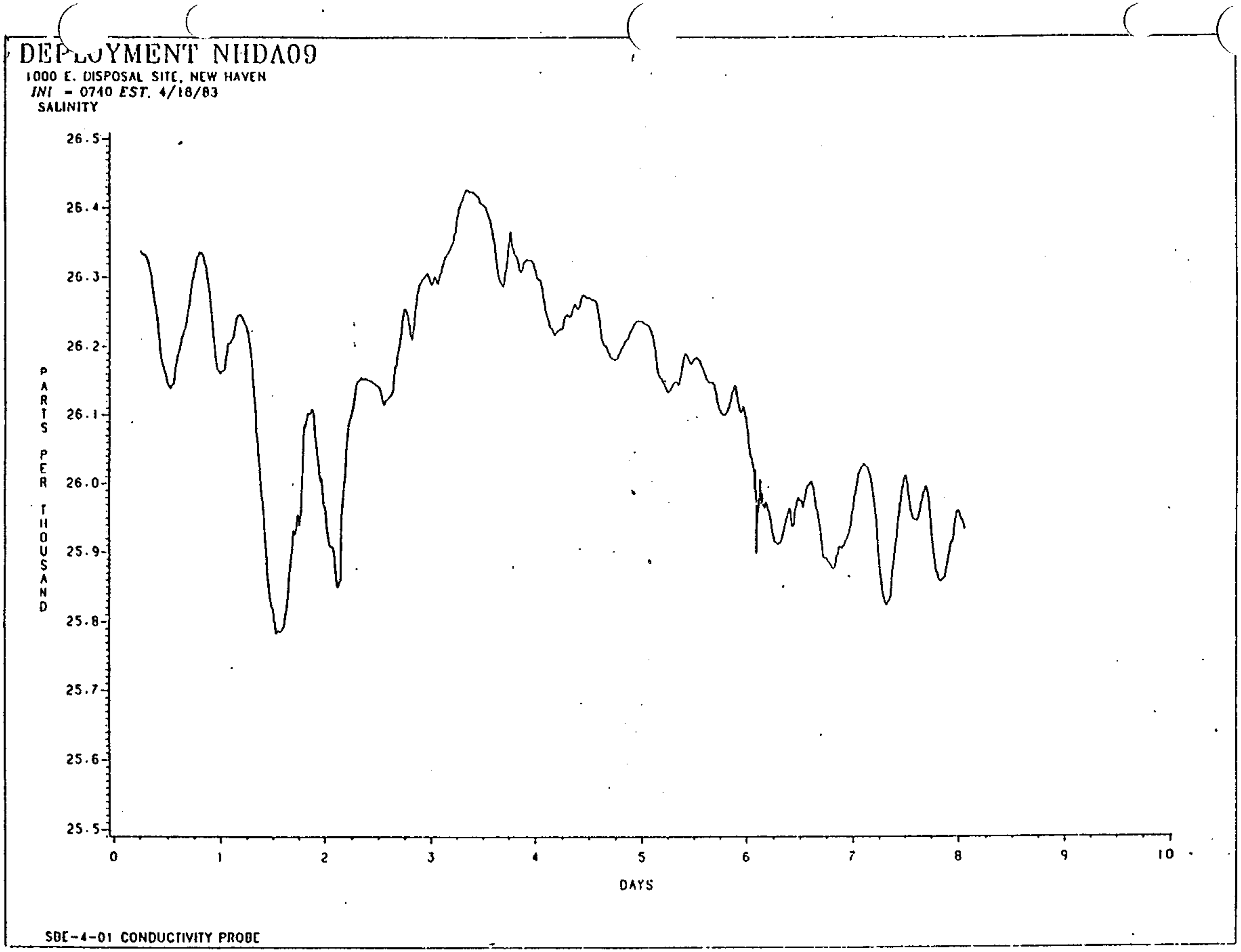

FIGURE III-3-71. Salinity- Near Bottom
Deployment NHDA09

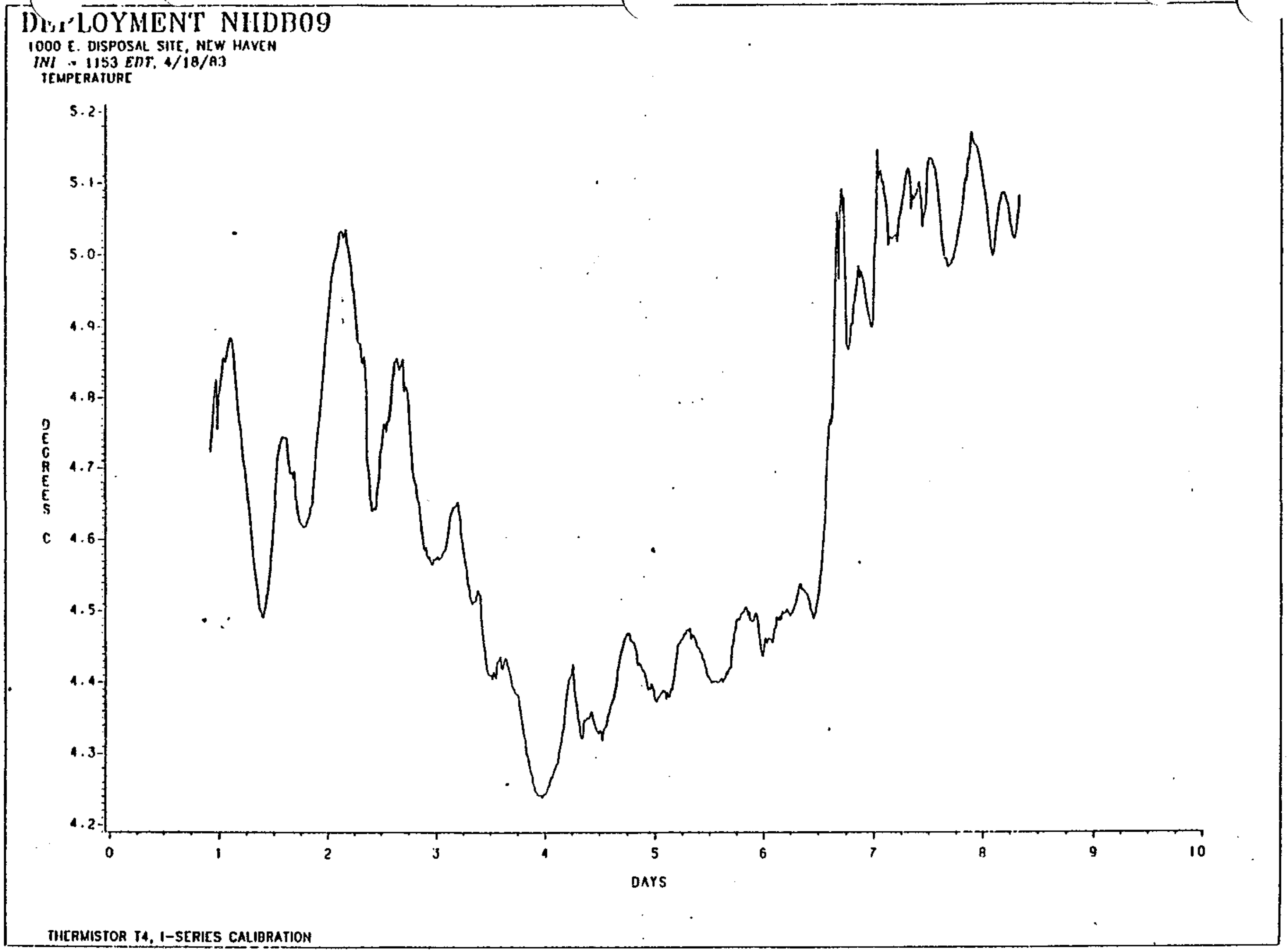

FIGURE III-3-72. Water Temperature - Near Bottom
Deployment NHDB09

the optical windows during less active periods generally do not lead to significant accumulations. Materials settling under these conditions appear to be progressively winnowed or removed from the sampling volume by current during the higher speed portions of the tidal cycle. As a result, the long-term suspended material record does not show a progressive increase in background levels, but is rather characterized by a series of three-to-four day period oscillations on which the tidal variations are superimposed. This difference in the output characteristics allows discrimination of the factors dominating the ambient suspended material field and may prove useful within efforts to determine the stability of the FVP deposit and the extent to which erosion of these materials contributes to the local suspended material field. Such discrimination, however, requires reasonably comprehensive data describing conditions within the overlying water column. In particular, information detailing biological productivity, blooms, and the like would be required.

In addition to the regular tide associated variations and the longer term, lower frequency deviations induced by particulate settling and/or fouling, the time series observations also provide some indication of the response characteristics of the suspended material field to short-term, high-energy storm events. Although this period of observation is relatively free of significant storm events, the single event observed on Day 19 of NHDD06 (Fig. III-3-56) indicates that an increase in near-bottom energies due to the presence of a reasonably energetic surface-wave field will tend to induce increased resuspension from the sediment-water interface. This response suggests that the local sediment column is, under most conditions, in near-equilibrium with the ambient transport system. Resuspension observed during each tidal cycle appears to be primarily the result of agitation of an assemblage of materials that lies just above the sediment-water interface. Although the present data precludes accurate determination of the extent of this layer, it may be that these materials are sufficient to effectively protect the sediment-water interface from erosion under the normal or average energy conditions. This protection, or armoring, of the interface would be produced simply by the presence of the loosely aggregated assemblage of materials that effectively serves to dissipate some or all of the available transport energy.

3.5.2 During Disposal

Deployment NHDA10, 26 April - 23 May 1983

Suspended material concentrations during this deployment period displayed average values ranging from approximately 17 mg/l to slightly more than 20 mg/l. Concentrations in excess of this latter value, observed during the later deployment period after Day 15, appear to be primarily the result of sediment accumulations in and around the sampling volume and on the windows of the optical sensors. Biological fouling was not observed to be a significant factor during this period (Fig. III-3-73). Since review of the meteorological data for this period (Appendix III) indicates no significant storm events and generally low precipitation, the source of this abundant supply of material appears to be primarily resuspension associated with disposal. As previously noted, disposal of the FVP dredged materials was initiated on 26 April 1983, essentially coincident with the beginning of this deployment. The effects of these operations on the near-bottom suspended material field is evidenced in the output from the optical sensors as a series of relatively large amplitude, but short duration spikes, (see e.g. Fig. III-3-73 Day 2, Day 2.5, Day 4, Day 5, etc.). These spikes represent the characteristic signature of a disposal operation and have been observed previously at several active sites within Long Island Sound. These perturbations typically represent the highest frequency component of the optical record and serve to supplement the characteristic tidal variability evident in all observations obtained at the Central Long Island Sound disposal area. These latter tidal variations, evident throughout Figure III-3-73, induce a regular cyclic variation in near-bottom suspended material concentrations with values varying by approximately $\pm 20\%$ about the mean. Such regular variability appears generally representative of late spring-early summer conditions within the Central Sound.

Sediment resuspension associated with the disposal of the FVP dredged materials appears sufficient to produce a slight increase in the average output signal from the optical sensor. This increase in signal level, however, does not appear to be the result of an actual increase in ambient suspended material concentrations, but rather to be an artifact induced by sediment accumulations within the sampling volume of the sensor. As previously discussed, these accumulations are slowly removed from within the sampling volume by the local flow field causing a progressive decrease in sensor output. Such a cycle of resuspension, deposition and trapping within the sampling volume and subsequent removal by ambient flows, followed by another resuspension event, induced a low frequency variability in the output from the optical sensor. This low frequency variability is to be observed on several occasions within Figure III-3-73.

Near-bottom current speed during this deployment displayed a bi-weekly or spring-neap cycle with minima occuring in the vicinity of Day 9 (Fig. III-3-74). The coincidence of this neap tidal period with the time of minimum suspended material concentrations (Fig. III-3-73) suggests that some portion of the observed low frequency variability evident in the output from the optical sensors may be the result of variations in the rate of sediment resuspension from the vicinity of the sediment-water interface. Such sensitivity, not commonly observed during previous deployments at the FVP site, suggests an increase in the erodibility of the interface which is most probably associated with the presence of a reasonably large mass of recently placed dredged materials. Prior to consolidation and associated compaction, such materials are typically characterized by moderately high water content and susceptibility to current

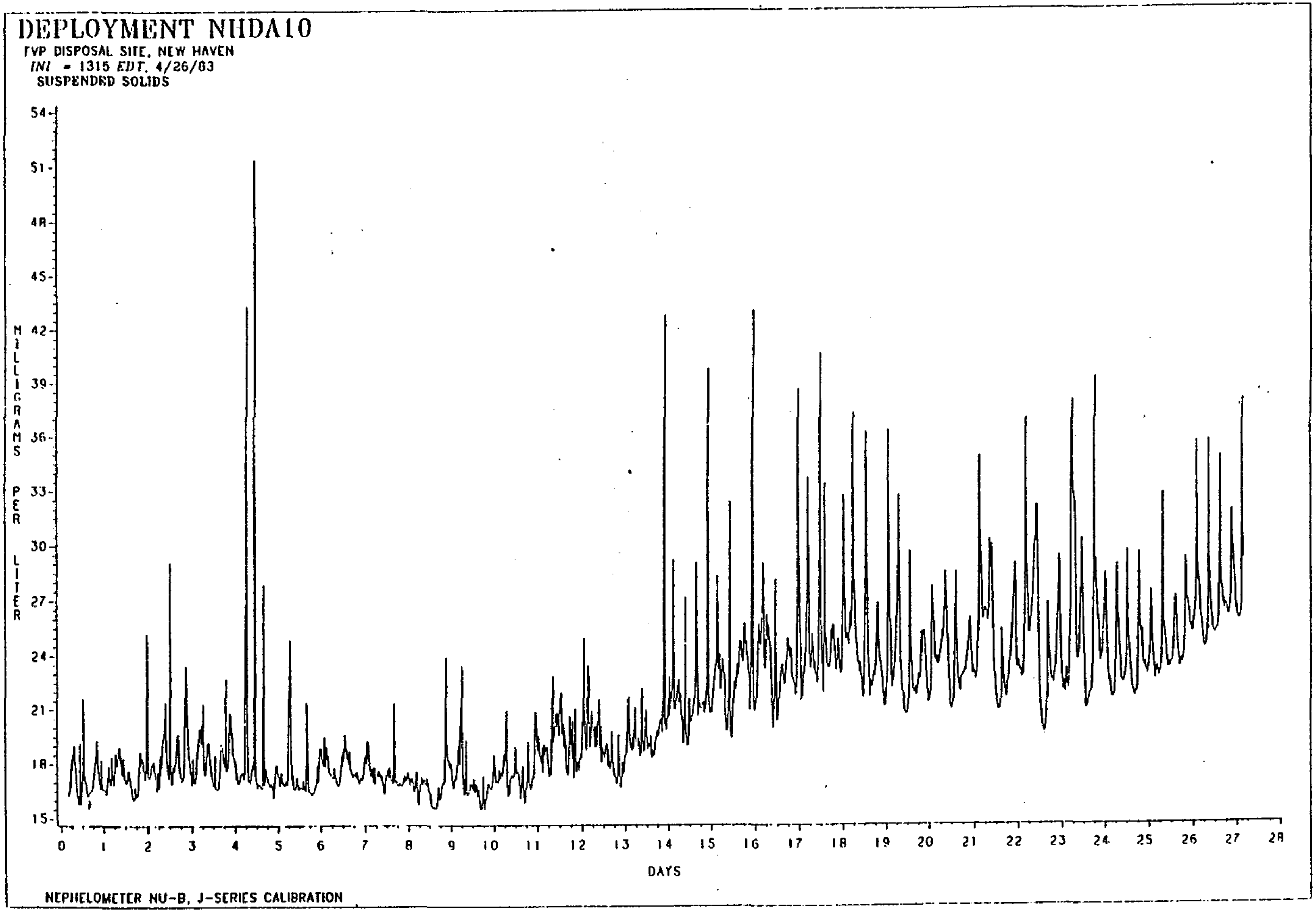

FIGURE III-3-73. Suspended Material Concentrations
Deployment NHDA10

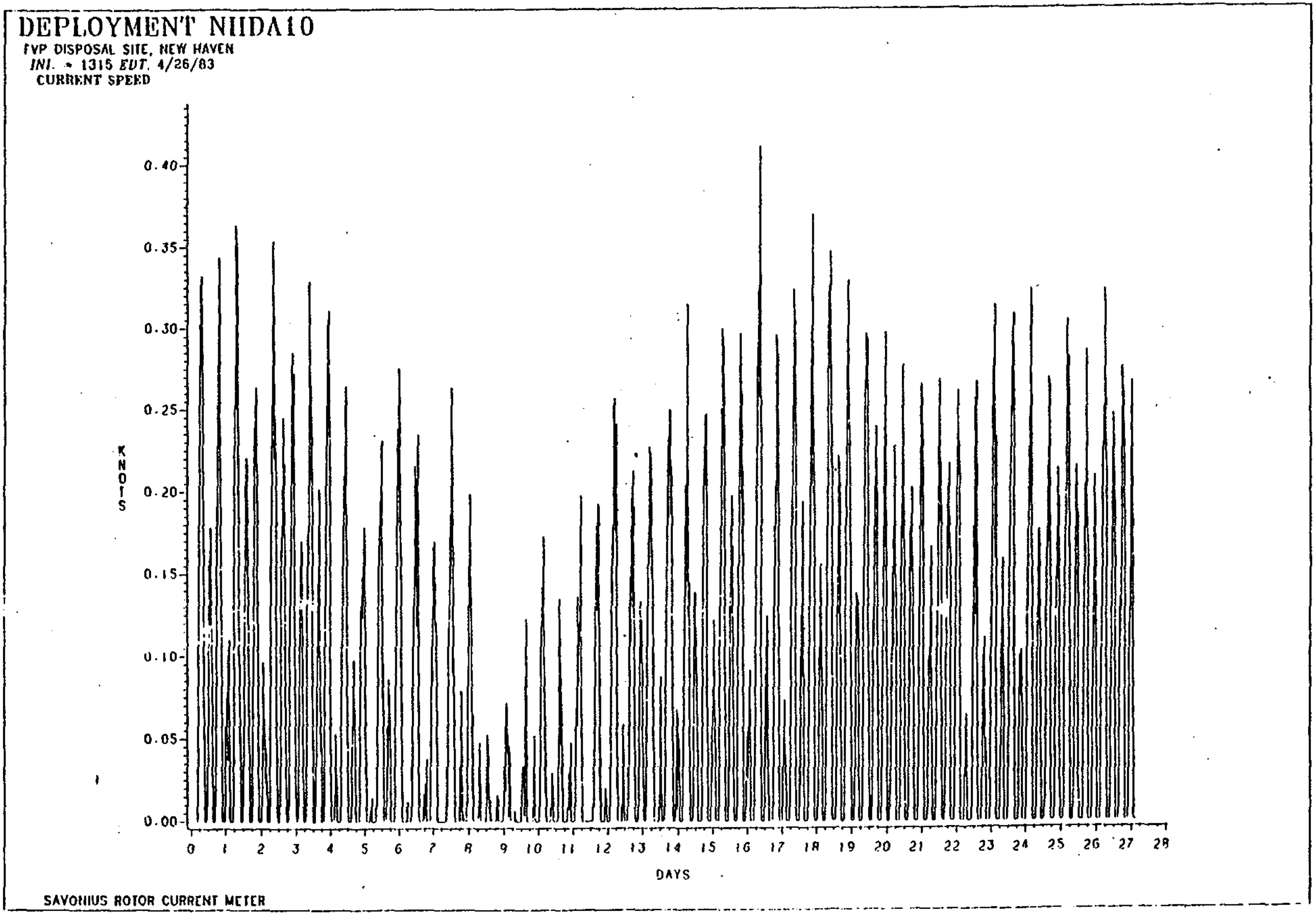

FIGURE III-3-74. Current Speed
Deployment NHDA10

induced dispersion. Such dispersion would initially vary simply as a function of near-bottom current speed and associated boundary shear stress resulting in low frequency variability in phase with the spring-neap cycle. Such variability would serve to supplement the low frequency signature associated with the above artifacts associated with sediment accumulations within the sampling volume of the optical sensors.

The decrease in the salinity of the near-bottom waters observed during the previous deployment continued during the first seven days of this deployment period (Fig. III-3-75). After Day 7, salinities increased by approximately $2^{\circ}/oo$ over the next two weeks and then began a progressive decrease which persisted over the remainder of the deployment period. This pattern provides some useful information concerning the response time of the Central Sound to variations in streamflow from tributary rivers, but appears to be only weakly correlated with the near bottom suspended material concentrations adjacent to the FVP site.

Water temperatures over the deployment period displayed a progressive increase with values ranging from approximately $6.5^{\circ}C$ at the start of the period to nearly $10.5^{\circ}C$ on Day 27 (Fig. III-3-76). As has been previously discussed, these variations appear to be primarily the result of a progressive increase in air temperature over the Central Sound. This pattern appears essentially independent of concurrent salinity or near-bottom suspended material concentrations.

3.5.3 Post-Disposal

Deployment NHDB11, 23 May - 16 June 1983

Average suspended material concentrations during this deployment remained generally high with values equalling approximately 18 mg/l. This value is substantially higher than those observed during the period prior to April 1982, and is essentially similar to those developed during the immediate pre-disposal period and sustained throughout the time of the disposal operation. Impressed upon this background average is a series of high and low frequency variations dominated by a series of large amplitude, short duration perturbations (Fig. 3-77). The characteristics of these perturbations appear quite similar to those produced by disposal-associated resuspension. The cause for this similarity cannot be simply specified. Records supplied by the U.S. Army Corps of Engineers indicate that all disposal at the FVP site was completed by 14 May 1983. As a result, despite the similarities to variations induced by disposal operations, the observed perturbations must be presumed to be the result of aberrant sediment resuspensions and/or the passage of detritus or other biogenic material.

The cause for the sharp variation in the character of the output signal from the optical sensor on Day 12 is not immediately apparent. Review of the meteorological records from the U.S. National Weather Service Station in Bridgeport (Appendix

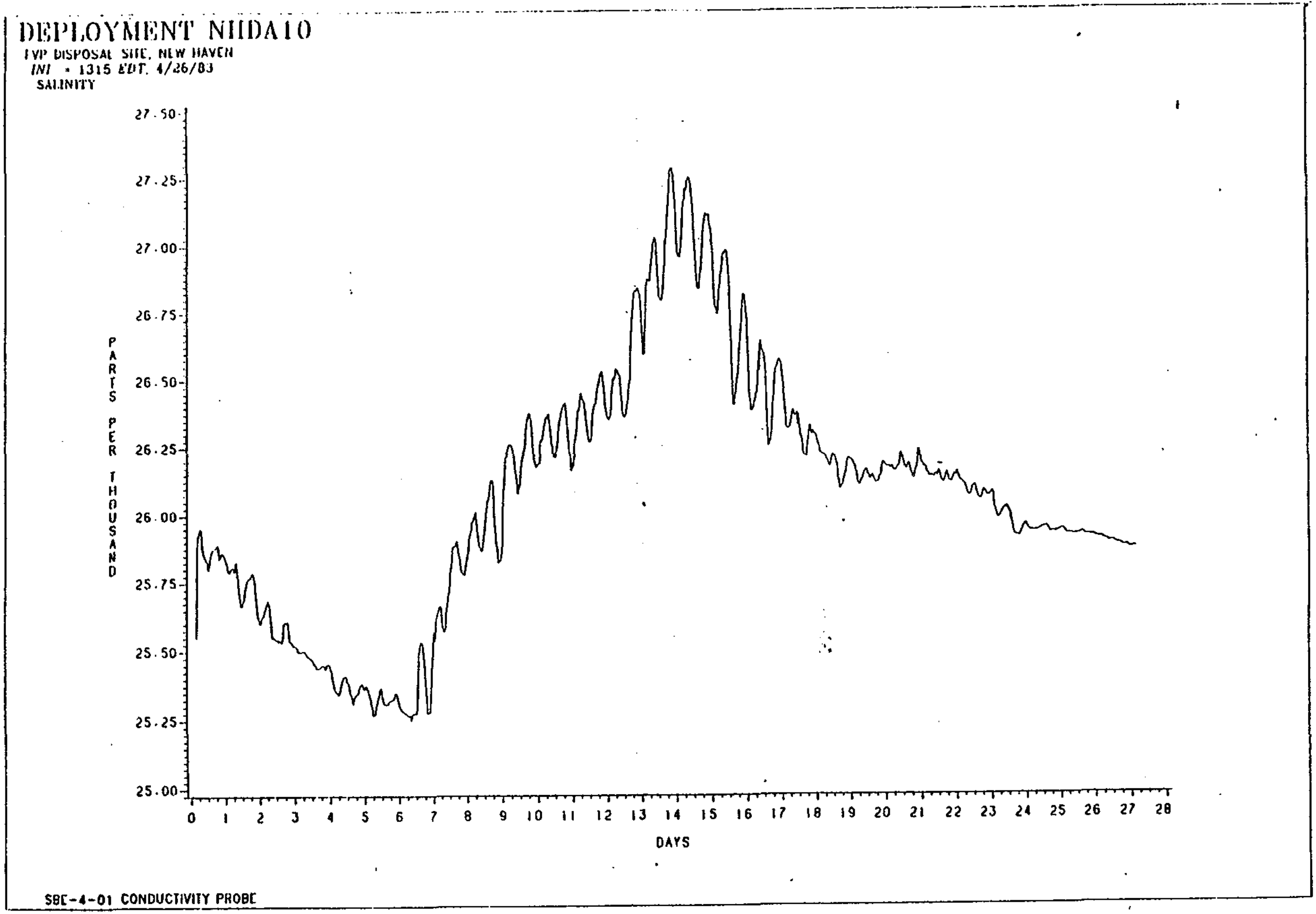

FIGURE III-3-75. Salinity - Near Bottom
Deployment NHDA10

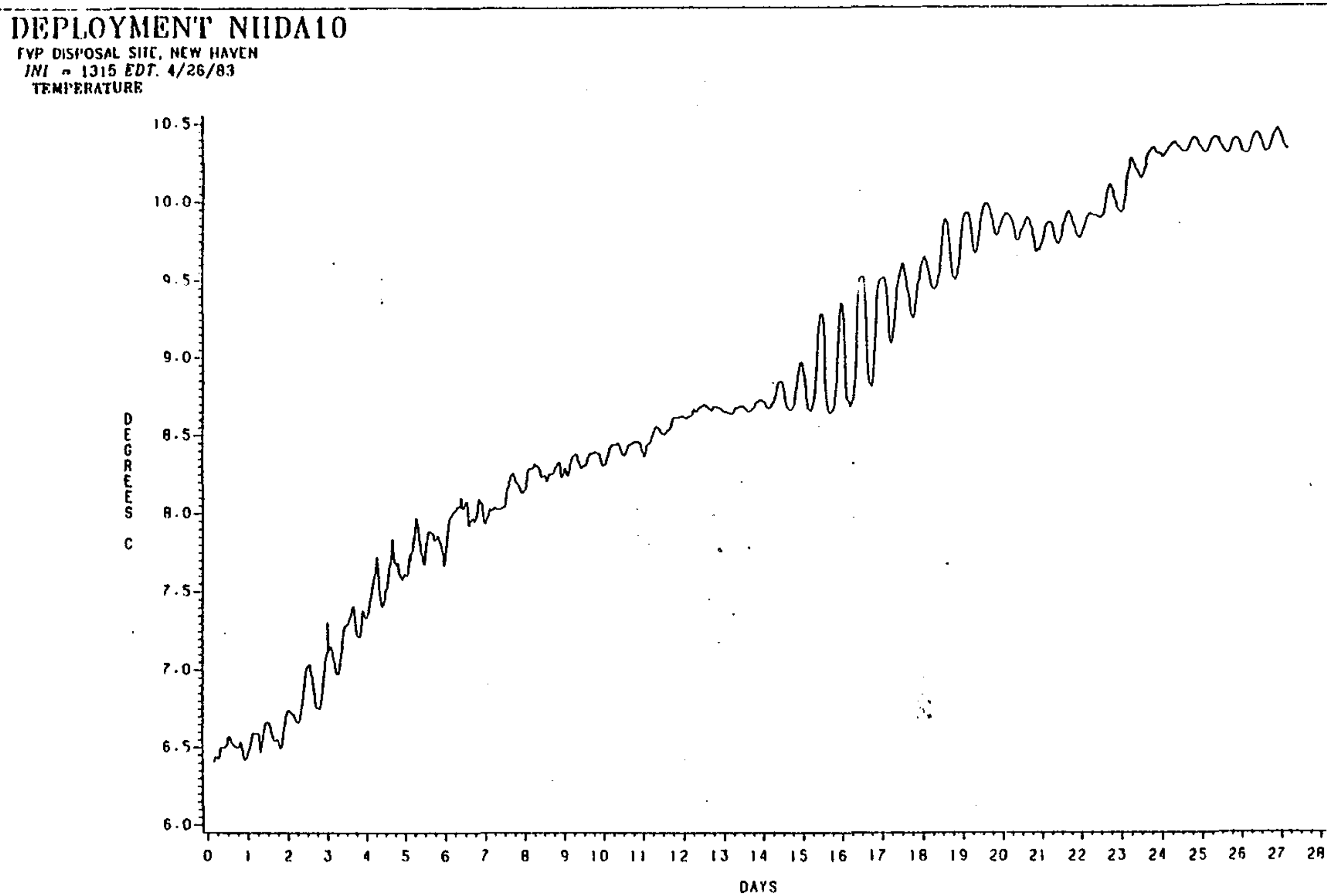

FIGURE III-3-76. Water Temperature - Near Bottom
Deployment NHDA10

THERMISTOR TU4, I-SERIES CALIBRATION

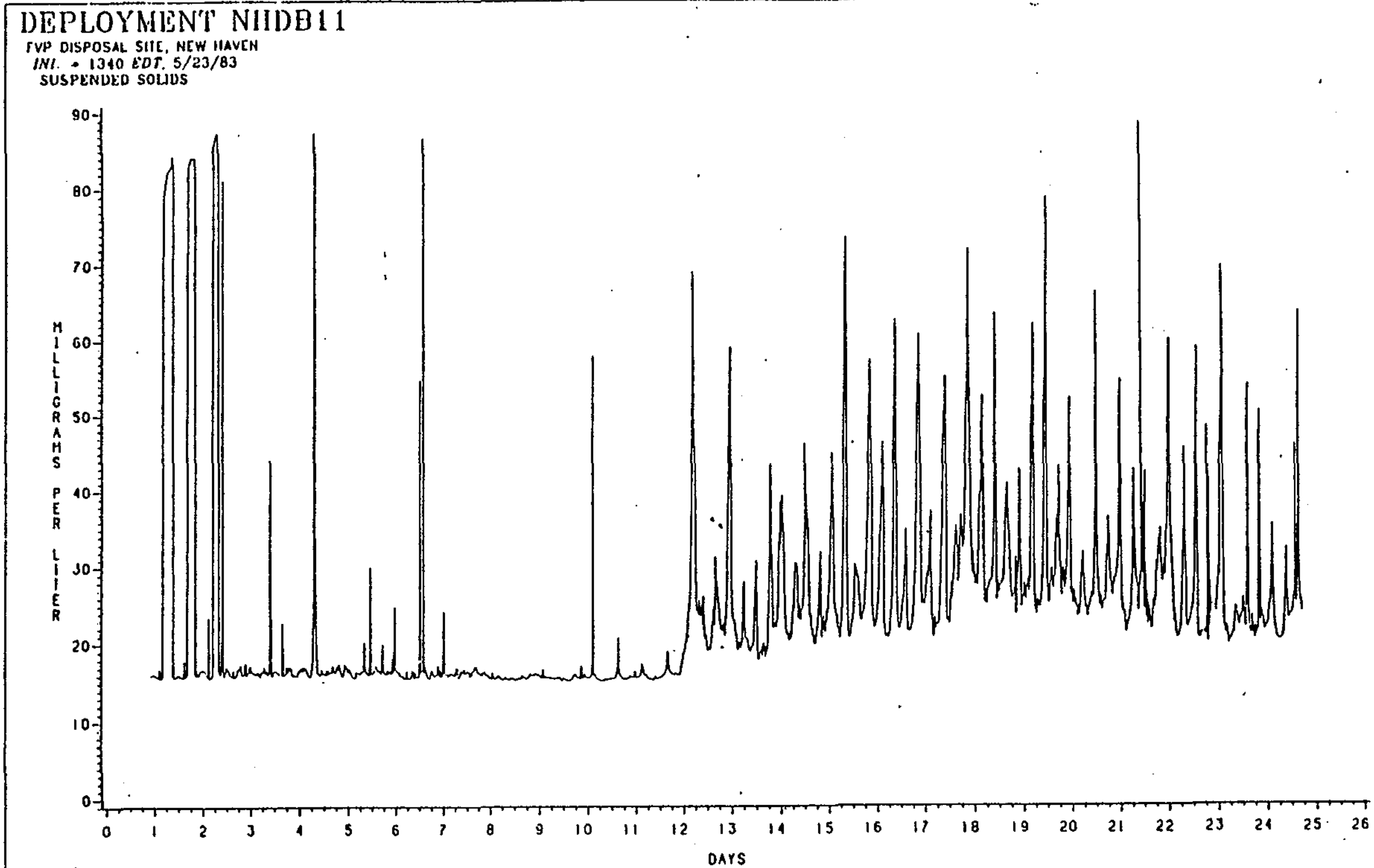

FIGURE III-3-77. Suspended Material Concentrations
Deployment NHDB11

NEPHELOMETER NU-A, M-SERIES CALIBRATION

III) indicates that, during this period, the area was affected by a short-duration storm event. Peak winds during the event were primarily from the west to southwest quadrant with speeds of approximately 25 mph. The event was extremely short-lived, however, and moved through the area in less than 24 hours. The variety of observations at the central Sound site suggest that such a generally low intensity system is not capable of producing significant sediment suspension. As a result, it must be presumed that the evident variation in signal quality is the result of accumulation of materials within the sampling volume of the optical sensor produced by either continuing disposal of dredged materials or other man-induced disturbance of the sediment-water interface such as fishing activity. Since the available records indicate no disposal activity at the site after 14 May, the latter activity must be presumed to be the cause of the variation in the output of the optical sensors after Day 13. The accuracy of this presumption cannot be easily evaluated. Since the character of the signal is not consistent with that typically produced by biological fouling and the mechanisms capable of producing sediment suspensions sufficient to induce accumulations within the sampling volume of the optical sensor have been effectively eliminated, mechanical agitation of the sediment-water interface appears to represent a reasonable cause for the variation in output signal quality.

The hydrography prevailing during the deployment period appeared similar to that previously in the central Sound for the late spring, early summer season. Current speeds displayed a regular spring-neap cycle (Fig. III-3-78) with maxima occurring on Day 3 and Day 21 and the minimum on Day 12. Concurrent directions displayed only limited variations throughout the deployment period (Fig. III-3-79). There is no apparent correlation between the low frequency variability observed within the output from the optical sensor and that displayed by the near-bottom current velocity. Water temperatures throughout this period continued to increase, reaching a maximum value of approximately 14^{o}C on Day 24 (Fig. III-3-80). As in all preceding observations, the low frequency variability within the water temperature record appeared governed simply by air temperature, while the high frequency fluctuations were dominated by water mass displacement driven by the semi-diurnal tide. Neither of these factors appeared to significantly affect near-bottom suspended material concentrations. Salinity data were not available for this deployment due to a sensor malfunction.

Deployment NHDA12, 16 June - 29 June 1983

Suspended material concentrations during this deployment period displayed values ranging from approximately 5 mg/l to 9 mg/l, on the average (Fig. III-3-81). These levels, and the progressive variation observed over the period appear essentially similar to those prevailing prior to April 1983, and can be considered to represent something of a return to background following a period of elevated average concentration

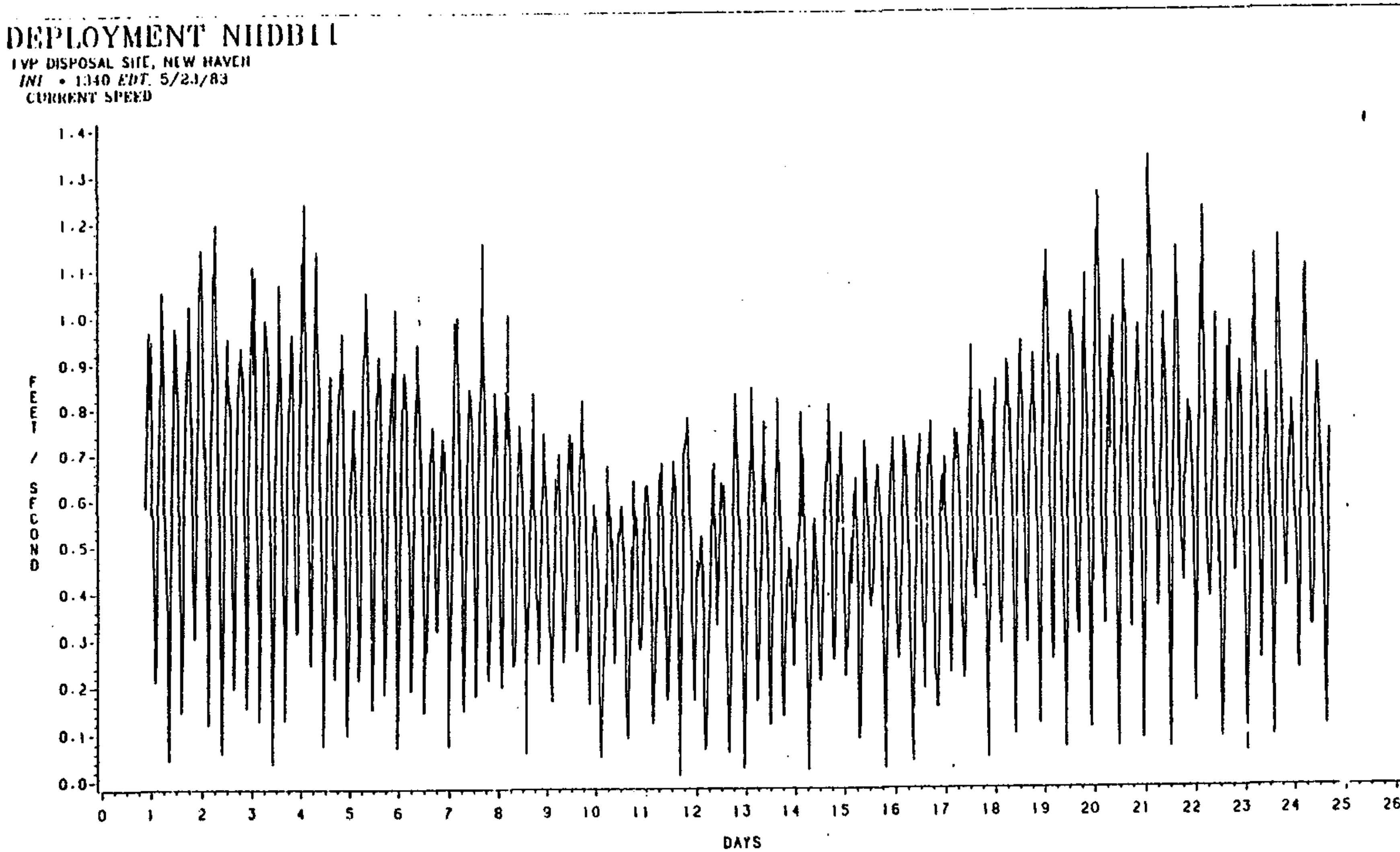

FIGURE III-3-78. Current Speed
Deployment NHDB11

MARSH MCBIRNEY 585 OEM CURRENT METER

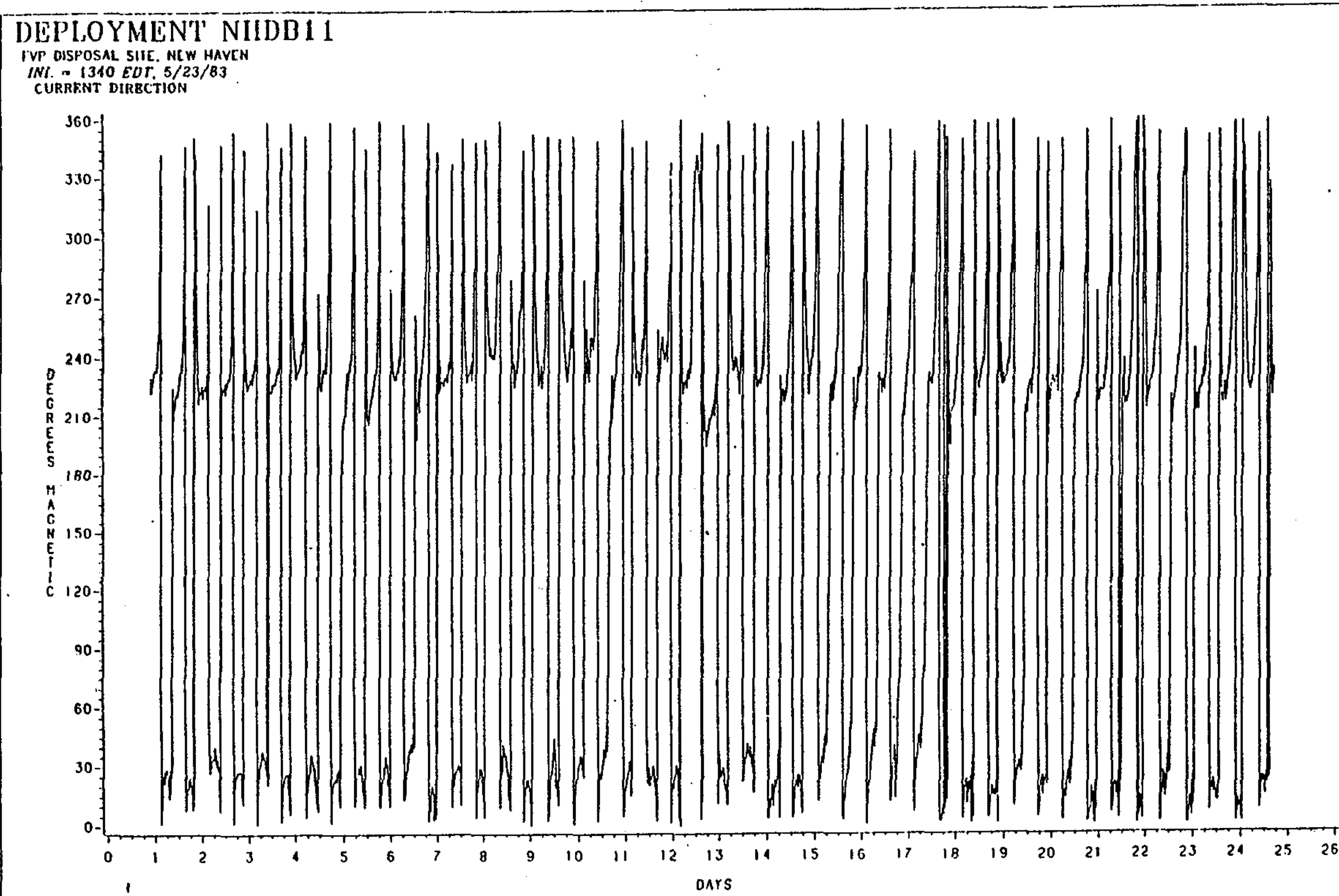

FIGURE III-3-79. Current Direction
Deployment NHDB11

MARSH MCBIRNEY 585 OEM CURRENT METER

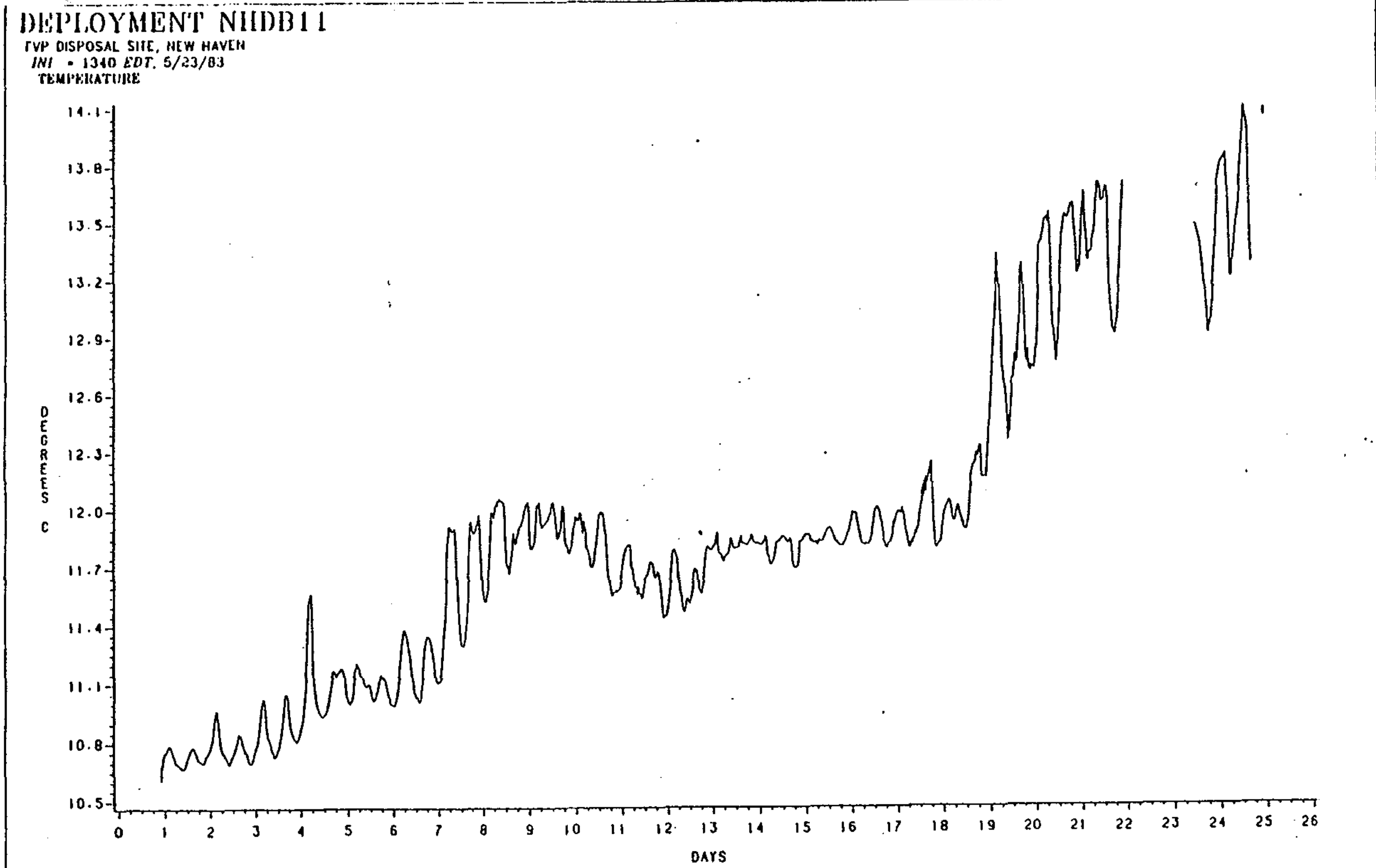

FIGURE III-3-80. Water Temperature - Near Bottom
Deployment NHDB11

THERMISTOR TU38, I-SERIES CALIBRATION

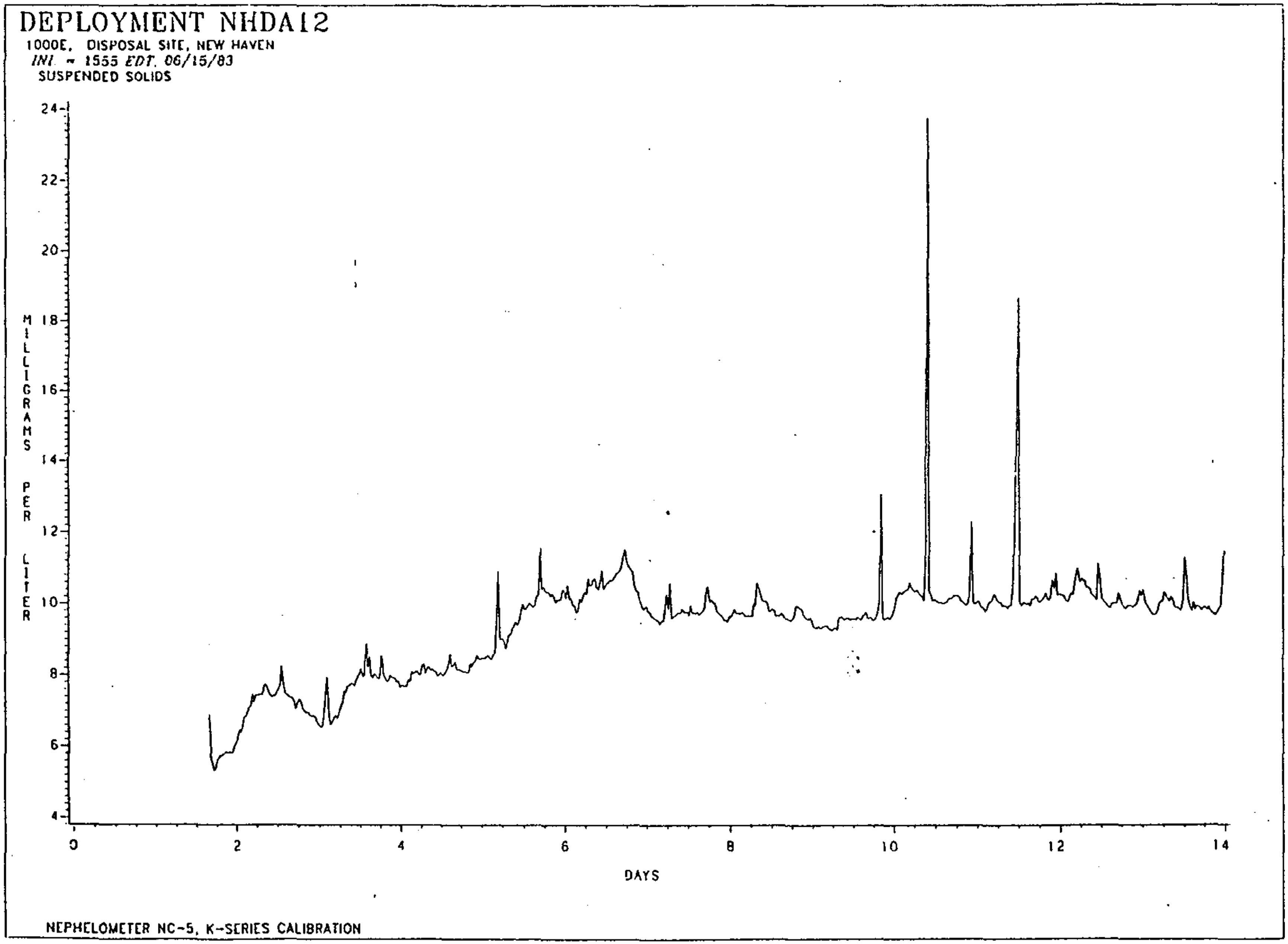

FIGURE III-3-81. Suspended Material Concentrations
Deployment NHDA12

values. As discussed above, the cause for this apparent increase appears to be primarily associated with increased supplies of river-borne suspended sediments following a period of high streamflows. The data, however, indicate a substantial delay in the decay of average suspended material concentrations relative to the time of decreasing streamflow. As noted, high discharge values in April had decreased substantially and were approaching the annual average by early May. This decrease was reflected in the near-bottom salinity data as values progressively increased through May, with an approximate two-week lag time. Concurrent suspended material concentrations, however, remained high throughout this period, finally decaying in early June more than six weeks after the period of peak discharge. Given the high settling velocities characterizing the majority of the materials forming the aggregate suspended material field, it appears unlikely that the extensive lag time is simply associated with the deposition of river-borne sediments. The maintenance of such elevated concentrations despite decreasing streamflows and associated sediments requires an alternate supply of materials. During disposal of dredged materials, suspensions resulting from the barge discharge and subsequent impacts of the descending sediments with the bottom can represent a source serving to increase local suspended material concentrations. Studies have shown, however, that these disposal-associated suspensions are typically short-lived and affect an extremely small area. As a result, they must be considered insufficient to produce the large-scale persistent increase noted over the preceding two deployments. Erosion of the deposited dredged materials can also contribute suspended materials to the local water column, perturbing concentration levels and favoring a general increase in average background levels. The available data suggest, however, that the majority of the sediments transported to the disposal area remain in place as a relatively coherent mound and that the erosion rates during the first two months following placement have been extremely low. Given such rates, it appears unlikely that the observed persistence in above average suspended material levels is the result of persistent erosion of the dredged material pile.

These comments suggest that the above average concentration levels observed during the months of April and May 1983 were most probably the result of a variety of factors rather than any single factor. Initially, the increase was most probably dominated by streamflow-induced increases in sediment supply. As streamflow decreased, dredging and subsequent disposal was initiated. Finally, erosion of the compacting pile and the supplementary effects of bioturbation supplied materials to the water column. As this last sequence of events proceeded, interface erosion over the surface of the pile decreased and associated sediment supplies were slowly eliminated. At the completion of the sequence, a new equilibrium state was established along the pile-associated sediment-water interface and suspended material concentrations within the adjoining water column returned to long-term average levels. This construct appears reasonably consistent with the available data.

In addition to the return to background, it is interesting to note that the output from the optical sensor for this deployment period continues to contain a significant number of short-term, high frequency perturbations or "spikes". As previously discussed, such spikes represent the characteristic signature of anthropogenic influence, including such activities as dredged material disposal and/or fishing. Again, although the cause of these perturbations cannot be simply specified, Corps records and local observation suggest that they are the result of this latter fishing activity. Given the prevalence of these spikes, it seems reasonable to assume that such activity represents a significant determinant of the ultimate character of the sediment-water interface within and adjacent to the FVP site, and may affect the erodibility and associated long-term stability of the deposited sediments. This factor should be evaluated in more detail in subsequent investigations.

The near-bottom hydrographic characteristics remained relatively invariant throughout the deployment period. In contrast to the condition observed during the preceding two months, salinities during this deployment period varied primarily in response to tidal forcing and displayed a narrow range of values (Fig. III-3-82). Water temperatures continued to display a progressive increase with values ranging from approximately 13°C on Day 1 to 15.5°C on Day 13 (Fig. III-3-83). As in the case of the salinity field, temperature fluctuations appeared dominated by tidal forcing. The magnitude of these fluctuations appears representative of spring tidal conditions. Examination of the near-bottom velocity data (Fig. III-3-84) indicates that spring conditions dominated throughout the deployment period, with peak speeds occurring on Day 5. These data also indicate a diurnal inequality and moderate variability in current direction (Fig. III-3-85). This combination of factors favors increased boundary shear stress and tends to maximize the probability of sediment resuspension. The fact that limited resuspension was indicated in the optical data suggests that the sediment-water interface of the dredged materials was reasonably stable and that, despite the relatively short time since disposal, a near-equilibrium had been established between the dredged materials and the ambient flow field. The factors governing this apparently rapid stabilization are poorly understood and represent a continuing interest of this investigation.

3.5.4 Summary

The characteristics of the near-bottom suspended material field in the area adjacent to the FVP site observed during the period April through June 1983 were essentially similar to those observed over the preceding year and discussed in the initial report in this series (Bohlen and Winnick, 1984). The system continued to display an evident high frequency variability dominated by the M2 component of the local tidal stream with concentrations during these fluctuations varying by approximately ±20% about the mean. This variability and, in particular, the incidence of apparent high concentrations of suspended sediment as indicated by the optical sensors during

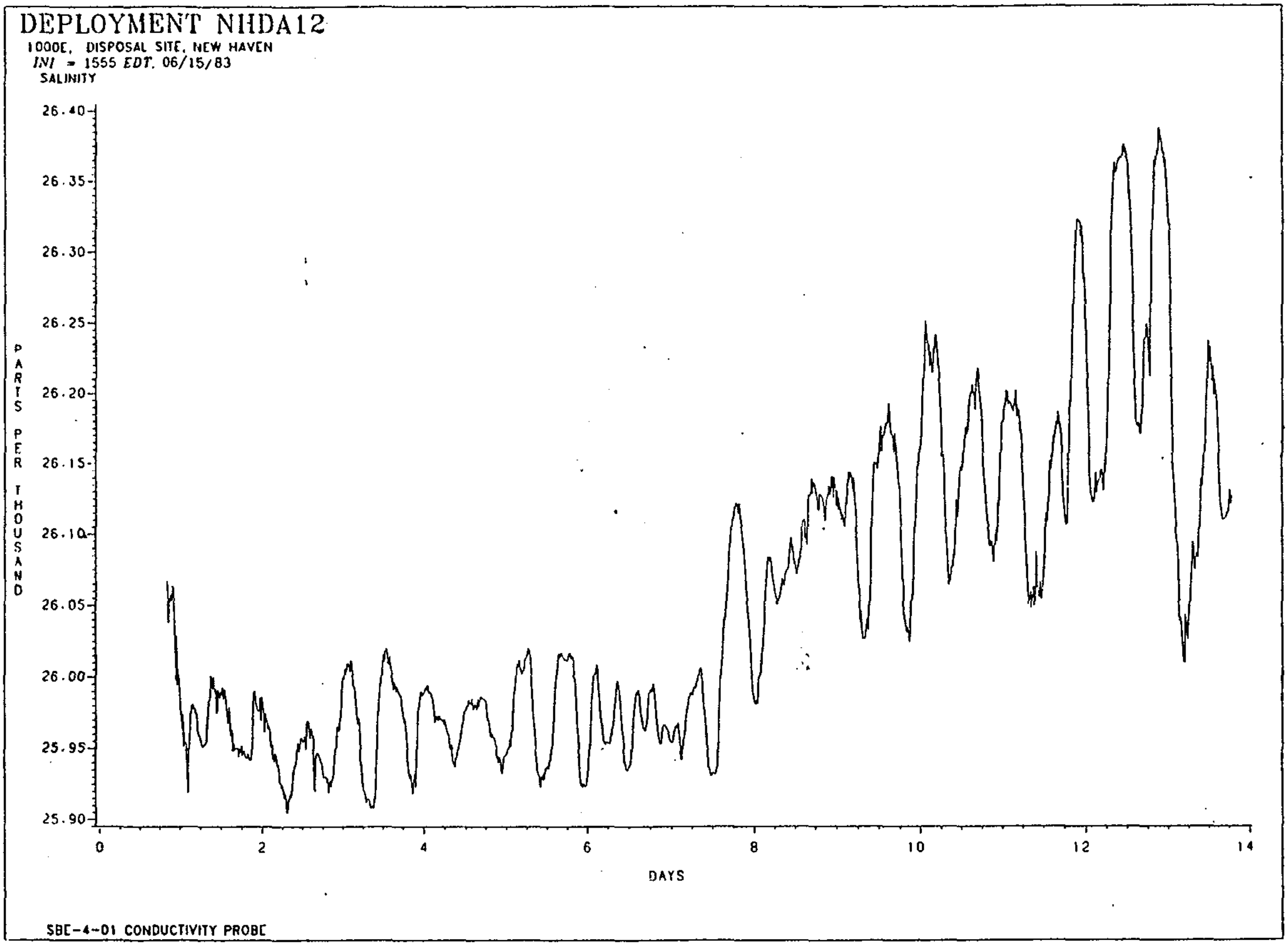

FIGURE III-3-82. Salinity - Near Bottom
Deployment NHDA12

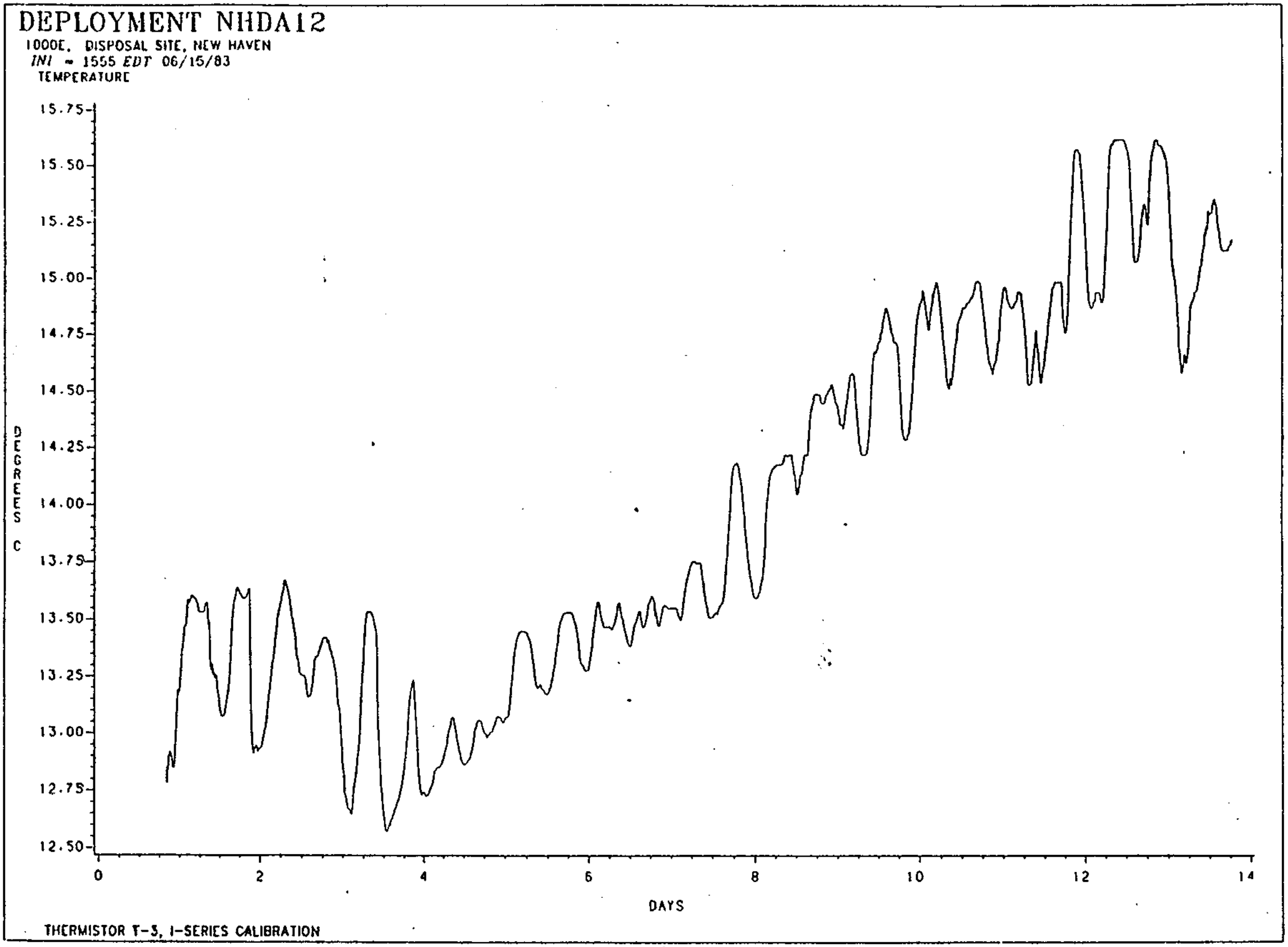

FIGURE III-3-83. Water Temperature - Near Bottom

Deployment NHDA12

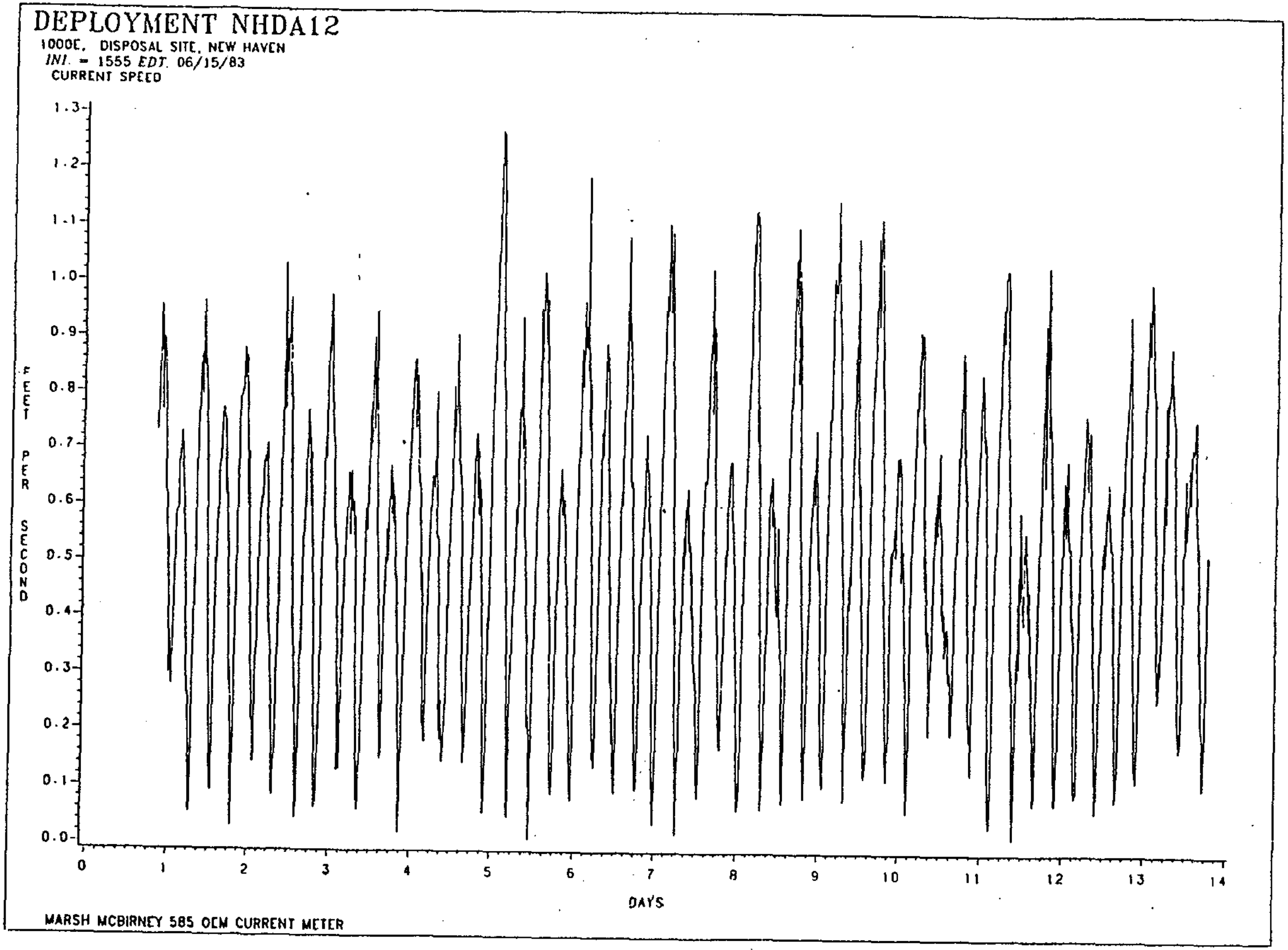

FIGURE III-3-84. Current Speed
Deployment NHDA12

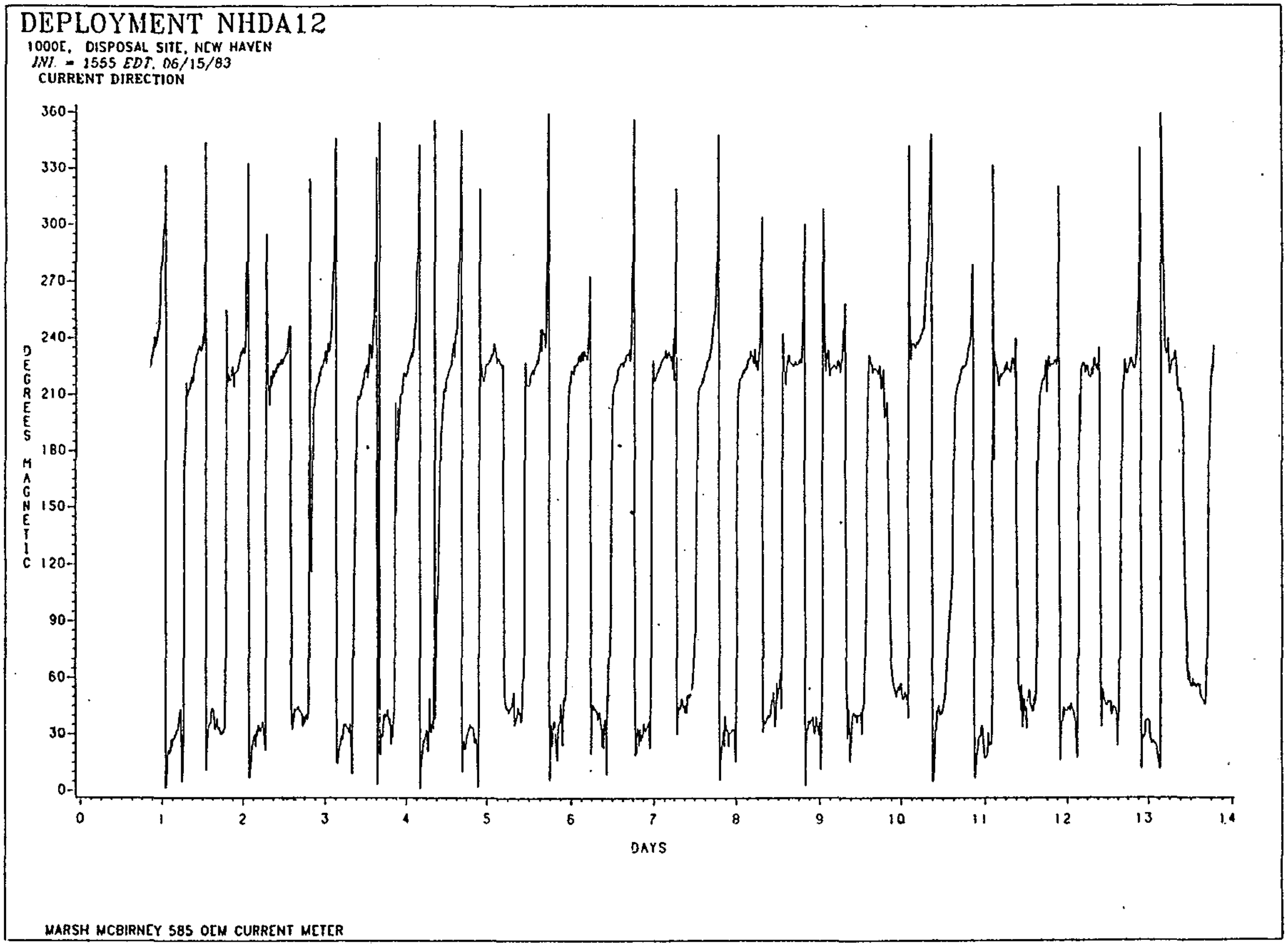

FIGURE III-3-85. Current Direction
Deployment NHDA12

periods of both high and relatively low or decreasing velocity suggests that the near-bottom suspended material field is composed primarily of aggregated, easily suspended sediments. This assemblage, supplied by a variety of sources both proximate and far-field, tends to form the characteristic "fluff layer" and appears to signficiantly affect the dynamics of sediment transport in the area immediately above the sediment surface The extent of this influence remains a subject of continuing interest within this investigation.

Supplementing the tide-induced, high frequency variations was a series of extremely short duration, large amplitude perturbations, apparently induced by fishing activity within and adjacent to the disposal area. These perturbations display many of the same characteristics as those produced by known dredged materials disposal operations and as a result complicate resolution of the direct effects of disposal on the local suspended material field. In addition, this fishing activity most probably serves to modify the roughness of the sediment-water interface and a variety of associated physical and geotechnical properties. These factors in turn serve to affect local sediment transport both directly and indirectly. Since records of fishing activity are difficult to obtain, the long-term effects within the sediment transport system cannot be simply determined. If such data is to be developed for the purposes of disposal area management, some effort to more accurately monitor fishing activity is recommended.

Despite the qualitative similarities, the suspended material concentrations observed during much of the April through June 1983 period were higher than those found during the preceding year. The cause of this increase initially was clearly related to increasing streamflows and associated river-borne sediments. Against this source, the materials suspended during the FVP disposal operations appeared to represent a relatively minor contribution. These operations were observed to produce characteristic short-term spikes in the suspended material field followed by a rapid return to backgound levels. There was essentially no indication that these perturbations resulted directly in an increase in background suspended material concentrations.

The factors governing the observed elevated suspended material concentrations during the period, characterized by rapidly decreasing streamflows, are difficult to simply specify. Salinity data suggest that some portion of this incrase was simply related to a lag in the response time of the suspended material field to increased sediment supplies provided by local river discharge. After approximately two weeks, however, these lag effects should decay and material concentrations, coincident with increasing salinity, should begin to decrease. The maintenance of high concentrations beyond this period suggests that other factors have developed sufficiently to offset the effects of decreasing streamflow and associated sediment supplies. These factors appear to be primarily associated with variations in the erodibility of the sediment-water interface in the areas adjacent to the disposal area, and possibly water column-associated supplies of organic materials. The relative importance of these various factors cannot be simply specified using the data developed by the array (DAISY). Approximations based on the observed times associated with elevated concentrations suggest that the dredged materials may, because of increased erodibility during initial settlement and compaction, represent a source of materials contributing to the persistence of the high background levels initially induced by high streamflows. The return to the long-term average suspended material concentration levels by mid-June would suggest that approximately 30 days was required for the surface of the mound to reach an equilibrium with the ambient flow field characterized by generally low persistent erosion. Comparisons of this time scale with observed rates of biological recolonization (or colonization) and time history of the geotechnical properties of the dredged material pile would provide at least some initial indication of the importance of erosion of the surface of the dredged materials producing the elevated concentration levels. Such comparisons are recommended for inclusion within the next phase of this investigation.

3.6 Sediment Physical Properties

Geotechnical measurements of the Black Rock Harbor sediments were undertaken as part of a concurrent study of the capping operations of that dredged material in the northwest corner of the CLIS. The primary goal of this ongoing effort is to determine changes in sediment properties associated with dredging and disposal operations (DAMOS Contribution #38). Also the Troxler Nuclear Density Probe was evaluated as to its accuracy and reliability for in-situ measurement of sediment density.

3.6.1 Nuclear Density Probe

A series of density measurements were made within Black Rock Harbor after dredging was completed. The measurement locations are shown in Figure III-3-86 and the results are presented in Table III-3-22 and Figure III-3-87. The smaller numbers in Figure III-3-86 are locations of core samples obtained prior to dredging operations. (Unfortunately, the ND probe was not available during the pre-dredge coring study.)

An interesting aspect of the Black Rock Harbor measurements was definition of the sediment-water interface. When pushing the probe into the bottom, there was no obvious increase in resistence coinciding with an increase in density which would indicate a discrete surface. Later investigations with a dual frequency sonar further substantiated such observations through detection of a substantial "fluff" layer. Figure III-3-88 presents a record of the Black Rock Harbor bottom made with a 27 kHz system, which shows a sediment layer with a distinct low reflectance which lies between peaks of sediment with higher reflectance. Figure III-3-89 is a dual frequency trace through the same region which indicates an extensive fluff

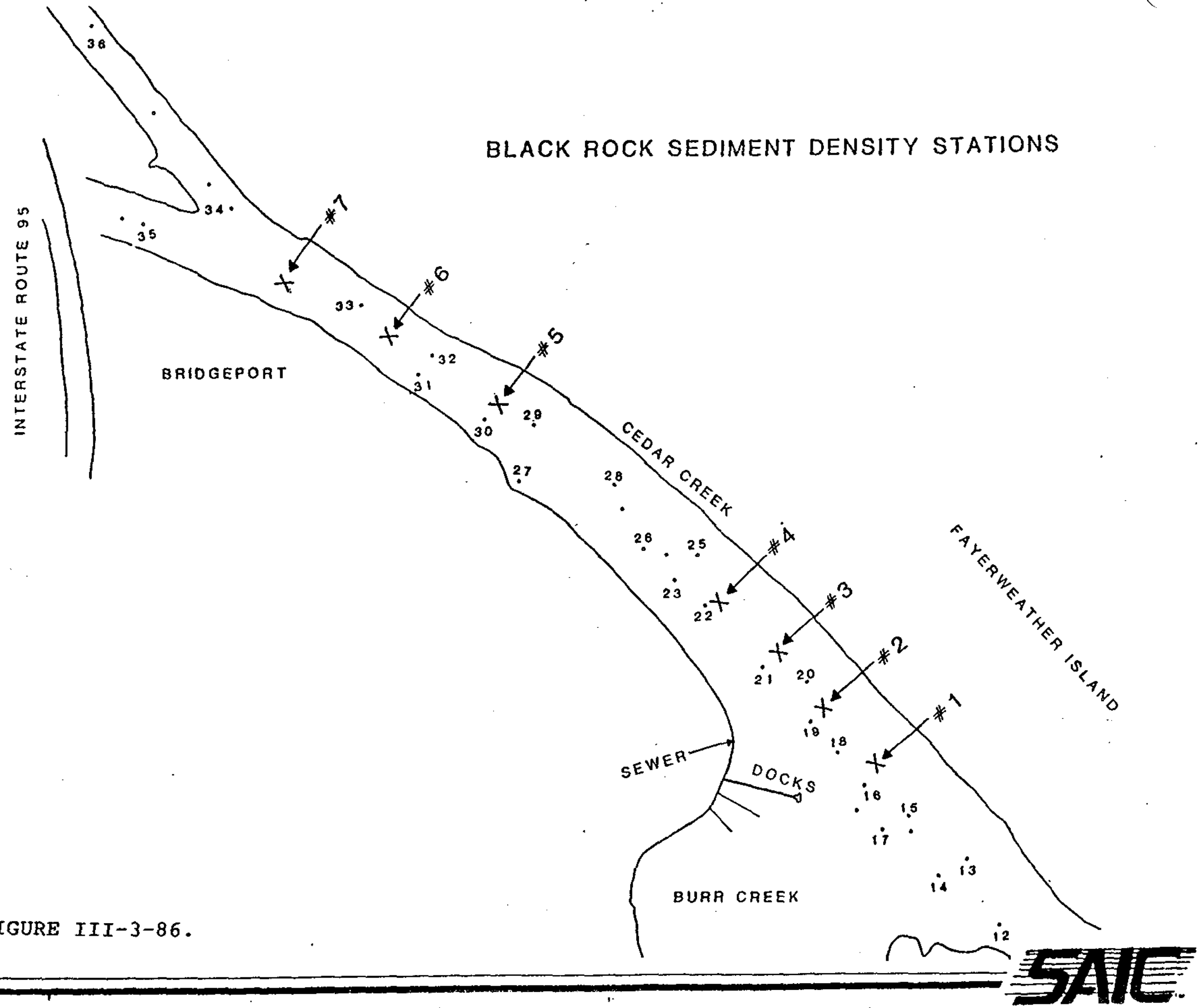

FIGURE III-3-86.

TABLE III-3-22

Sediment Density Measurements
Black Rock Harbor
June, 1983

Sta #	Depth (m.)	Density (cm^3)	Sta #	Depth (m.)	Density(g/cm^3)
1	-1.8	1.017	5	-2.0	1.022
	- .3	1.032		- .6	1.022
	0	1.168		0	1.146
	.3	1.212		.3	1.187
	1.5	1.191		.6	1.209
				.9	1.191
				1.5	1.187
2	- .9	1.013	6	- .6	1.024
	- .3	1.018		- .3	1.088
	- .1	1.059		0	1.246
	0	1.148		.3	1.165
	.9	1.198		.6	1.185
	1.2	1.334		1.2	1.342
	1.5	1.286			
	1.8	1.295			
	2.0	1.327			
3	-1.5	1.018	7	- .9	1.016
	- .9	1.019		- .6	1.016
	- .3	1.021		- .3	1.084
	0	1.135		0	1.231
	.3	1.154		.3	1.313
	.6	1.180		.6	1.275
	.9	1.215		.9	1.587
	1.2	1.285			
	1.5	1.489			
4	-2.0	1.019			
	- .6	1.036			
	0	1.209			
	.3	1.206			
	.6	1.763			
	.9	1.807			

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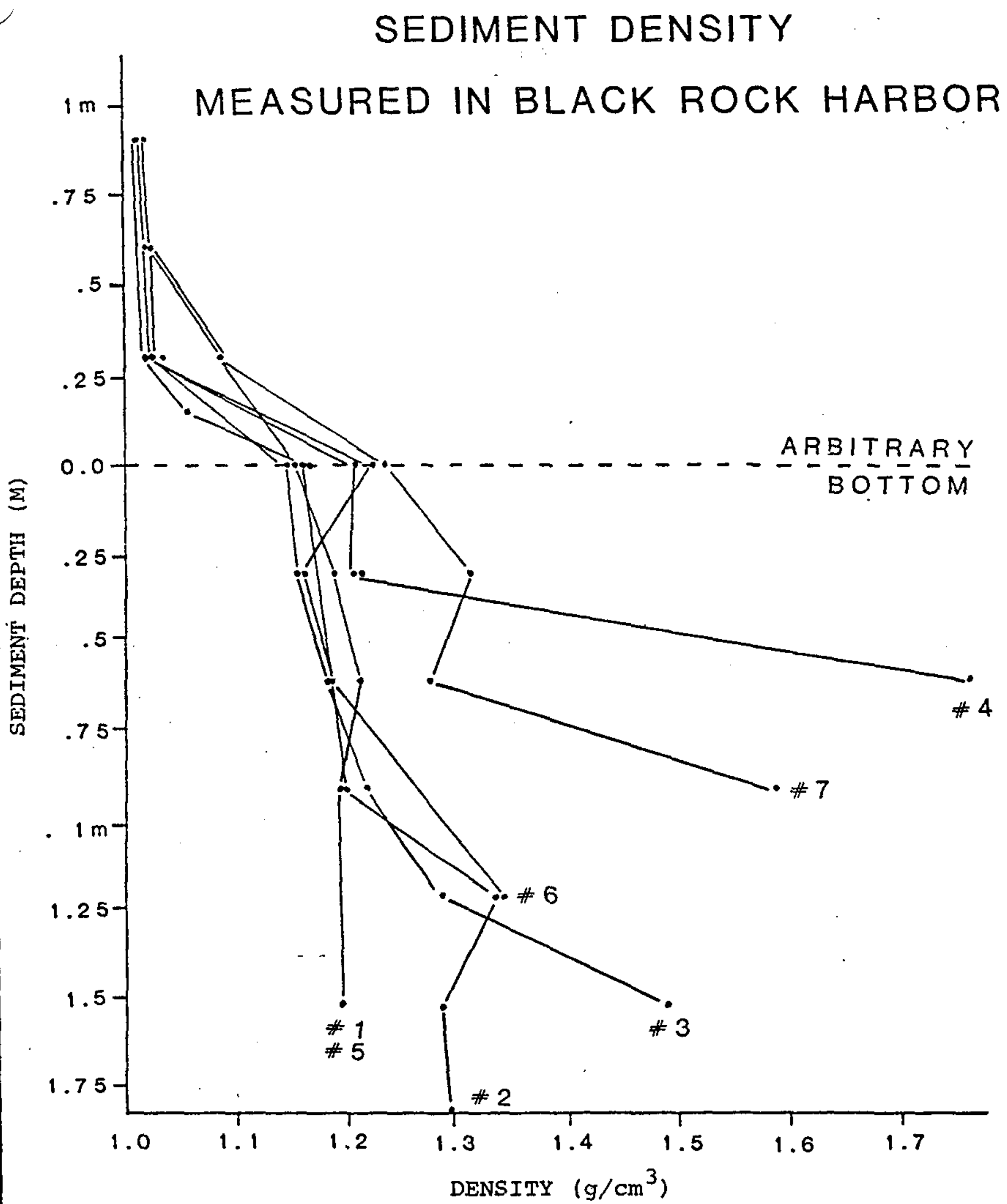
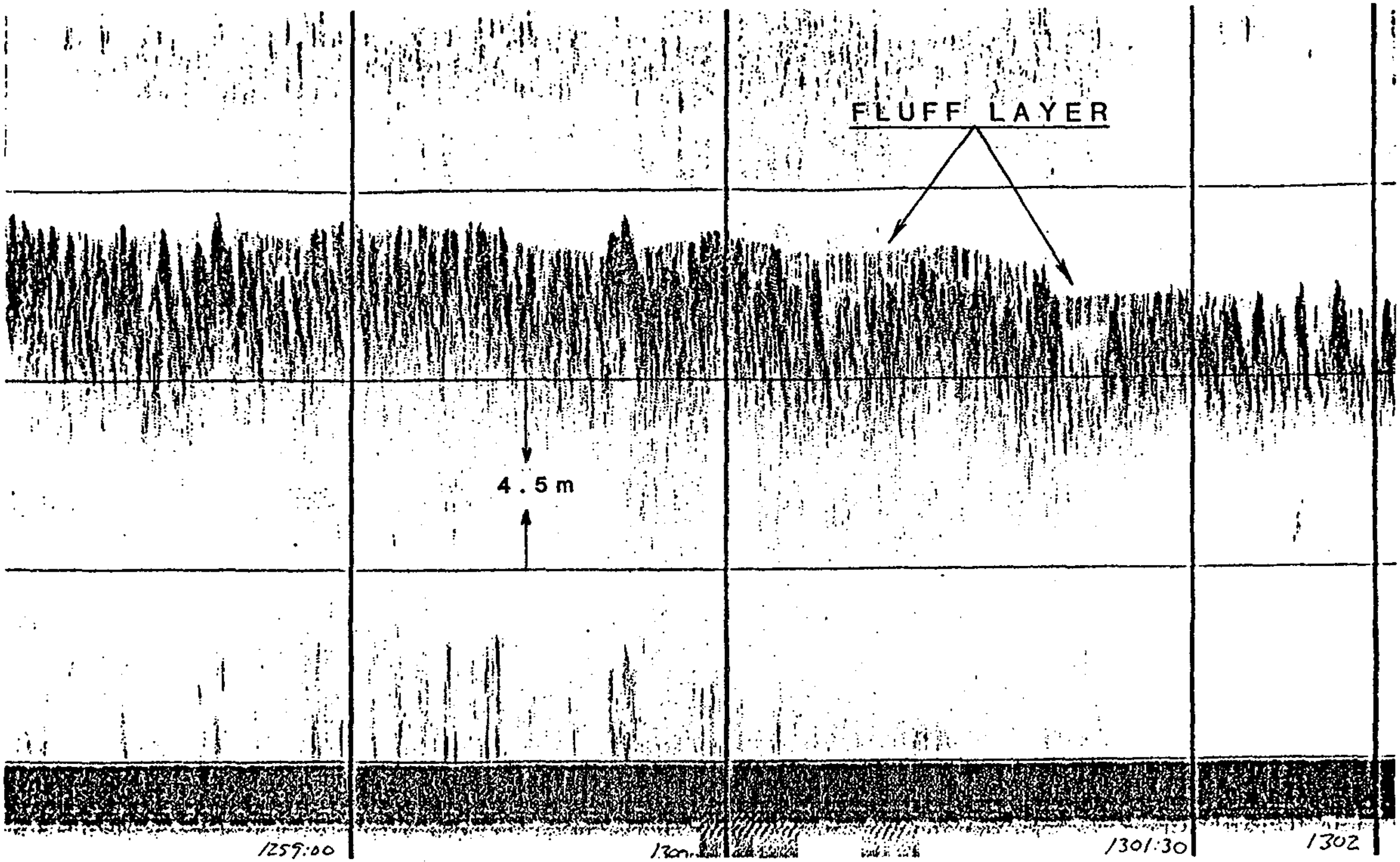


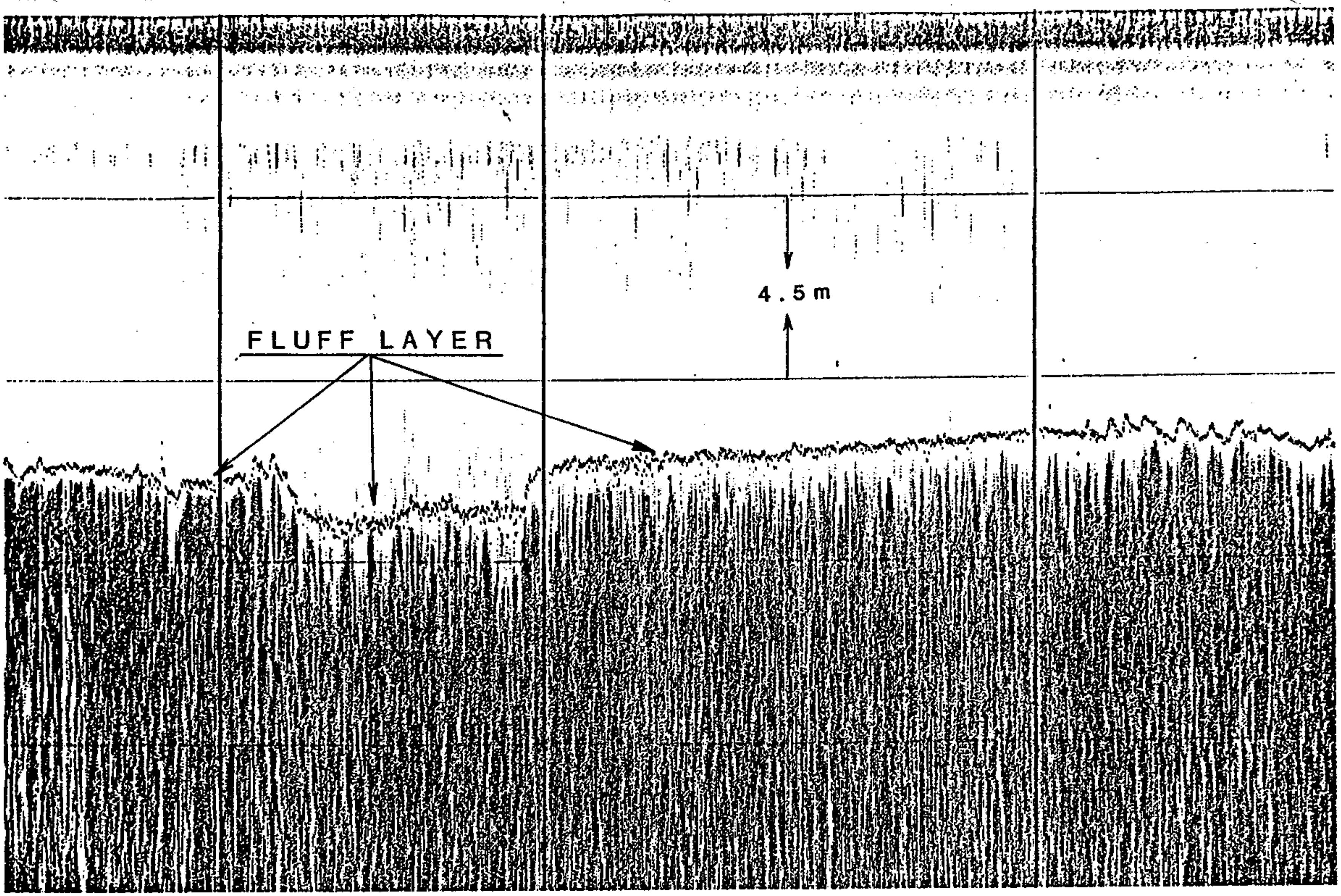
FIGURE III-3-87



27KHz SONAR TRACE
BLACK ROCK HARBOR

FIGURE III-3-88

SAIC



3.5/200 KHz
DUAL FREQUENCY SONAR TRACE
BLACK ROCK HARBOR

FIGURE III-3-89

SAIC

layer, approximately .5m thick, as measured by the 200 kHz system, overlying more dense material observed by the 3.5 kHz signal.

In order to relate density measurements made under these conditions, the probe was lowered at equal increments of .3m and the sediment surface was arbitrarily defined as the level at which a significant increase in density occurred. In most cases, this increase was at least .1 gm/cm^3. However, in some samples such as #2, #6 and #7, the increase was more gradual, indicating the presence of a fluff layer. There was also a marked increase in density with depth in these measurements. Measurements made at less than 50 cm from the sediment-water interface averaged 1.193 g/cm^3 while those made at greater than 50cm averaged 1.33 g/cm^3. This upper value is close to the mean of 1.20 for the density of samples obtained prior to dredging and analyzed by laboratory methods as shown in Table III-3-23. The sediment below 50 cm is significantly more dense and probably represents undisturbed material. From these data, it is readily apparent that the dredged material from Black Rock Harbor consisted of a significant amount of low density sediment slurry, some of which remained as a fluff layer and some of which was obviously transported to the disposal site in the scows. Furthermore, it is apparent from the sub-bottom profiles in Figures III-3-88 and III-3-89 that more dense material was also dredged.

In addition to density measurements, grain size and Atteburg limits were also determined for these samples (DAMOS #38). Atteburg limits are engineering parameters used to test the plasticity of sediments. These results indicate that Black Rock sediments have high plasticity and are composed of fine silt with extremely high liquid limits. This is probably associated with the high organic content of the sediment.

Sediment density measurements were obtained from three scow loads during the dredging of Black Rock Harbor. The results of these measurements, presented in Table III-3-24, show relatively low density material in one scow load, while others showed a higher density, more typical of maintenance material.

In summary, the sediments from Black Rock Harbor were less dense than sediments from New Haven (1.20 versus 1.37 gm/cm^3). However, once dredged and placed in the disposal scows, there appeared to be a vertical layering of material according to density in each of the three scows and, frequently, relatively large differences between the mean density measured for entire scow loads and the mean density of the individual stations.

The density probe was also deployed at the disposal sites to assess the changes in density that occurred during the disposal operation. The penetration frame was used to sample transects across the mound at the FVP site. Each station was sampled by placing the frame on the bottom and inserting the probe in 50cm increments. The results of the measurements are presented in Table III-3-25.

TABLE III-3-23

Black Rock Harbor
Pre-Dredging Geotechnical Properties

Sta #	Density g/cm^3	Mean Grain Size	Liquid Limit	Plastic Limit	Plasticity Index
16	1.18	.012	213	76	137
17	1.24	.043	147	55	92
18	1.15	.012	204	77	127
19	1.17	.014	209	73	36
20	1.15	.010	210	78	32
21	1.18	.039	202	84	118
22	1.16	.009	204	76	128
23	1.16	.013	186	69	117
24	1.19	.012	195	75	120
25	1.19	.015	155	63	92
26	1.28	.048	123	54	69
27	1.23	.021	158	63	95
28	1.16	.035	210	68	142
29	1.24	.031	122	52	69
30	1.26	.035	126	54	72
31	1.17	.014	192	73	119
32	1.17	.015	199	69	130
33	1.33	.043	142	55	87
$\bar{X}$=	1.20	.023	177	67	99
σ=	.08	.014	33	10	33

TABLE III-3-24

Sediment Density Measurements
Black Rock Harbor Disposal Scow
May 1983

DEPTH	SCOW #1 DENSITY	SCOW #2 DENSITY	SCOW #3 DENSITY
.5m	1.119 g/cm^3	1.173 g/cm^3	1.224* g/cm^3
1.0m	1.159	1.183	1.168
1.5m	1.182	1.230	1.212
2.0m	1.192	1.222	1.196
=	1.174	1.202	1.200

$\bar{x}$ = 1.191
σ = .029

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TABLE III-3-25

FPV DISPOSAL SITE

	25N						
	1.471						
	1.685						
	1.776 (1.0+)						
25W	CTR	25E	50E	100E	200E	400E	
1.430	1.395	1.354	1.279	1.357	1.430	1.433	
1.494	1.436	1.427	1.397	1.387	1.487	1.374	
1.420	1.487	1.493	1.455	1.489	1.409	1.452	
	25S						
	1.377						
	1.474						
	1.448						

(PROFILE INCREMENTS 50CM EXCEPT WHERE NOTED)
(All values expressed as g/cm^3)

POST DISPOSAL
DENSITY MEASUREMENT PROFILES
AT THE FVP DISPOSAL SITE
17 JUNE 1983

TABLE III-3-25 (Cont.)

FVP DISPOSAL SITE

50W	25N	
	1.345	
	1.346	
	1.411	

50W	CTR	
1.411	1.403	
1.457	1.432	
1.394	1.452	

	25S	
	1.372	(PROFILE INCREMENTS 50CM)
	1.365	(ALL VALUES EXPRESSED AS G/CM^3)
	1.436	

	1000S
	1.387
	1.367
	1.431

POST DISPOSAL
SEDIMENT DENSITY PROFILES
FVP DISPOSAL SITE
18 OCTOBER 1983

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Background density levels for natural sediment in the area averaged 1.378 gm/cm^3 with a 0.5 gm/cm^3 increase in density over the 1.5 m of penetration. Density levels on the disposal mounds were markedly different. The FVP mound was characterized by sediment densities on the order of 1.35 to 1.5 at the 50 cm level. The sediments at the site were more dense than the harbor sediments and the scow sediments. As indicated by the presence of a fluff layer in the harbor, much of the less dense, high water content material probably remained in the harbor, or, as shown by elevated suspended sediment levels, may have been dispersed at the site.

3.6.2 Coring Operations

During July 1983, 5 gravity cores were obtained at the FVP site. The core locations are presented in Figure III-3-90, and graphic presentations of core lithology are presented in Figures III-3-91 to III-3-95.

Typical natural bottom sediment in the disposal area consists of a cohesive silty-clay with relatively low water content and is generally light gray in color. This sediment was found at the base of all cores and apparently extends for several meters without much variability.

In spite of the low density, high water content, organic rich silt, that was characteristic of the upper layers of Black Rock Harbor sediment, a typical core from the FVP site contained relatively coarse sand with large amounts of organic detritus present. This material was predominant throughout the mound area but, at distances from 100 to 400 m from the disposal point, the sediment was finer and more similar to typical harbor material.

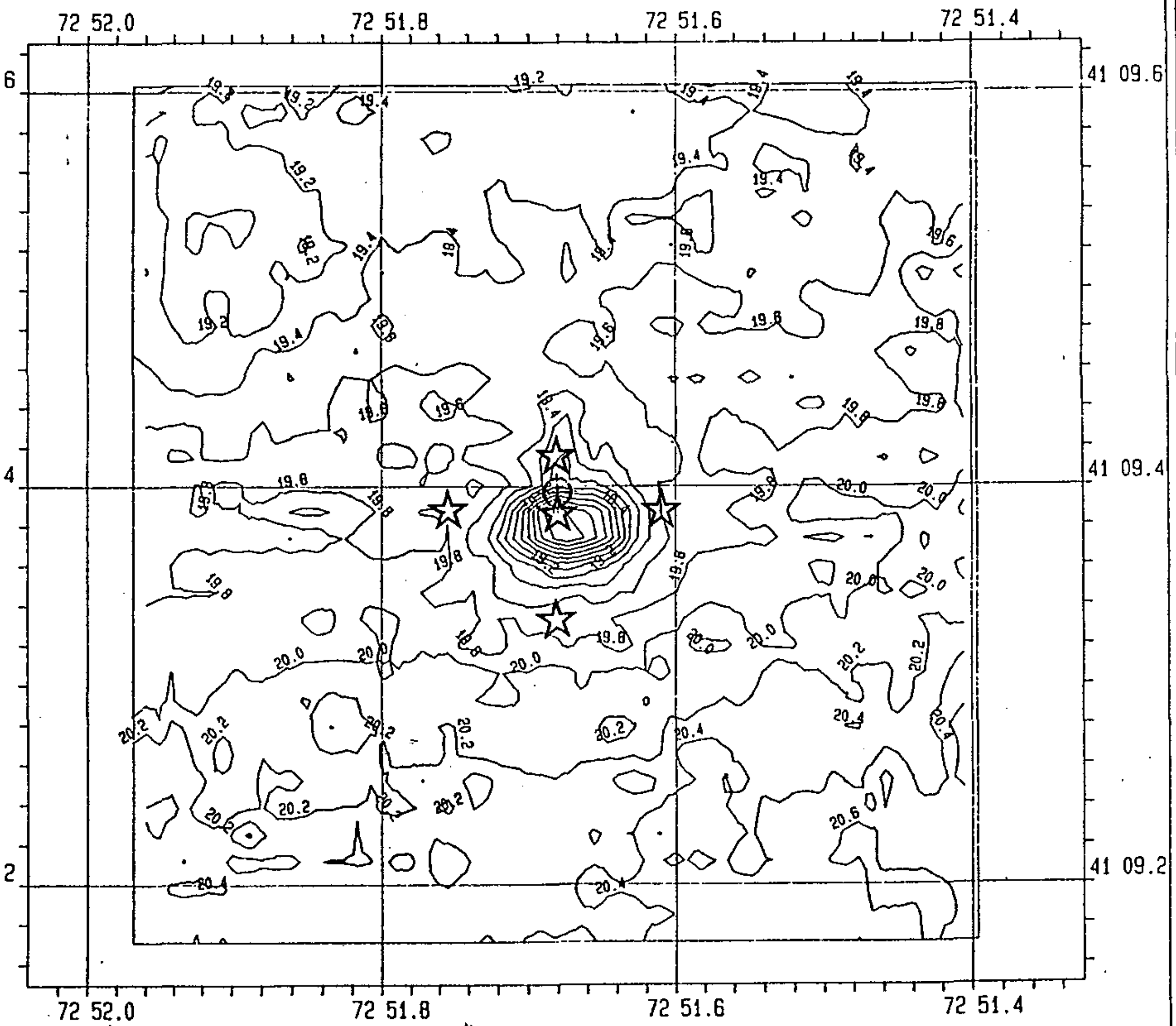
During June 1983, five surface samples were acquired at the FVP Long site using a Smith-MacIntyre grab sampler. After a grab sample was obtained, a thin-wall plastic tube with a 6.5 cm diameter and 15 cm length was pressed into the sample to recover sufficient quantity of sediment for geotechnical testing. These tube samples were capped and kept in refrigerated storage for later analysis. Each of the samples was subjected to a series of classification tests including determination of water content, Atterberg limits, particle size gradation, undrained strength and unit weight. In addition, several selected samples were subjected to consolidation and direct shear tests and organic matter content determination. These samples were selected to be representative of Black Rock sediment, cap material and natural bottom sediments in order to obtain strength and compression data for these different sediment types. Testing generally conformed to standard ASTM procedures except for the preparation of the extremely soft sediments for direct shear and consolidation testing, where no ASTM procedures for handling and trimming during soft sediment testing were available. The testing program and the results have been described elsewhere (DAMOS Contribution

FVP

POST-DISPOSAL

JULY 1983

☆-CORE LOCATION



0 80 160

SCALE (m)

FIGURE III-3-90

SEDIMENT CORES, FVP CENTER,
July 1983

Intermixed grey and black silt, fairly coarse grades

20.3

Granular black silt with strong odor

Granular sand layer 106.7
Brown silt 109.2
114.3
Black silt
119.4

Grey silt natural bottom with shell fragments at 129.5 cm

142.24

Field Log No. __________

Site FVP

Location Center

Date Sampled July 1983

Length of Core 142.2 cm

Diameter 6.5 cm

1 cm = 8 cm of core

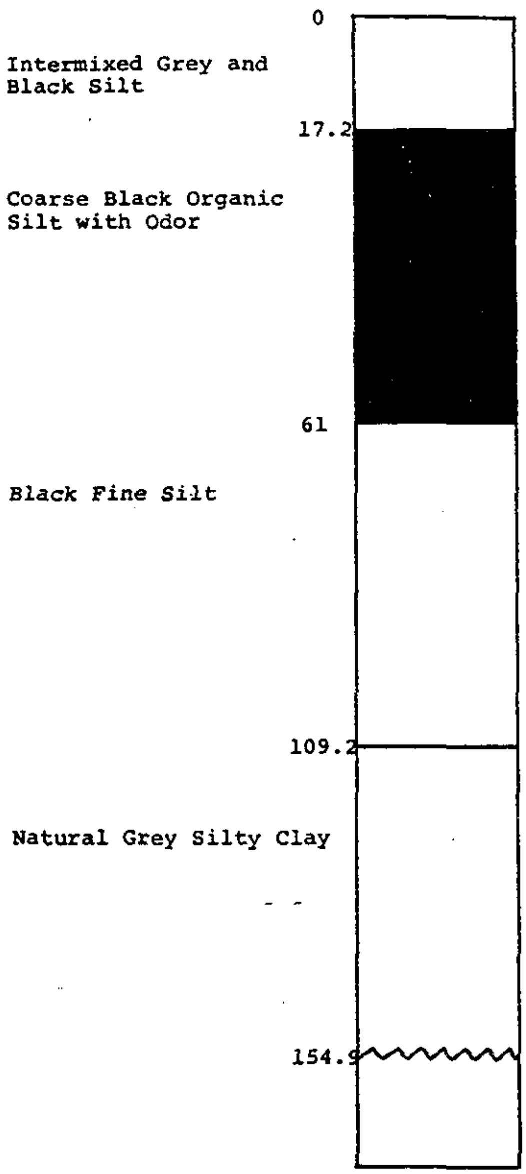
Darkened area indicates dredged material

FIGURE III-3-91

SAIC

SEDIMENT CORES, FVP-50N,

July 1983



Field Log No. ____________

Site FVP

Location 50 North

Date Sampled July 1983

Length of Core 154.9 cm

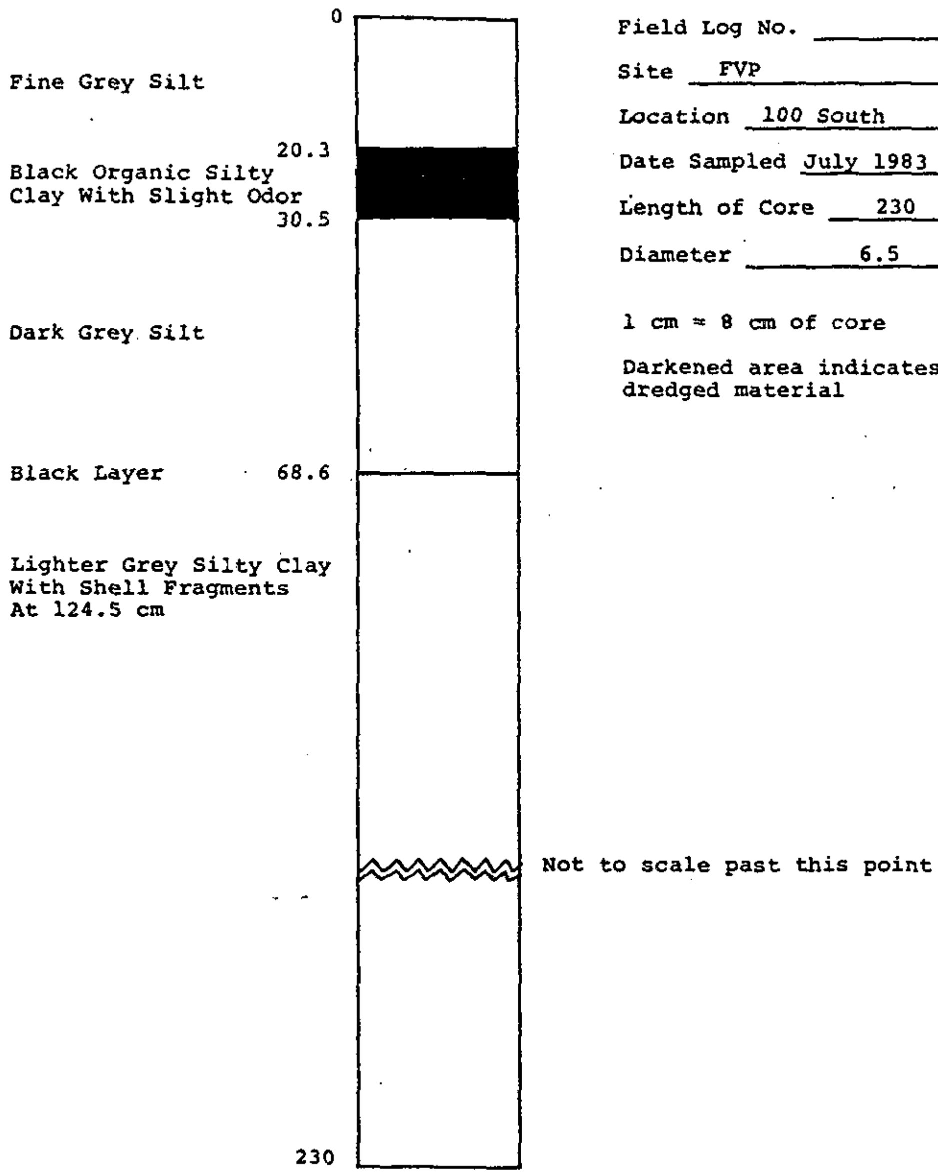
Diameter 6.5 cm

1 cm = 8 cm of core

Darkened area indicates dredged material

FIGURE III-3-92

SEDIMENT CORES, FVP-100S,
July 1983



Field Log No. ______

Site FVP

Location 100 South

Date Sampled July 1983

Length of Core 230 cm

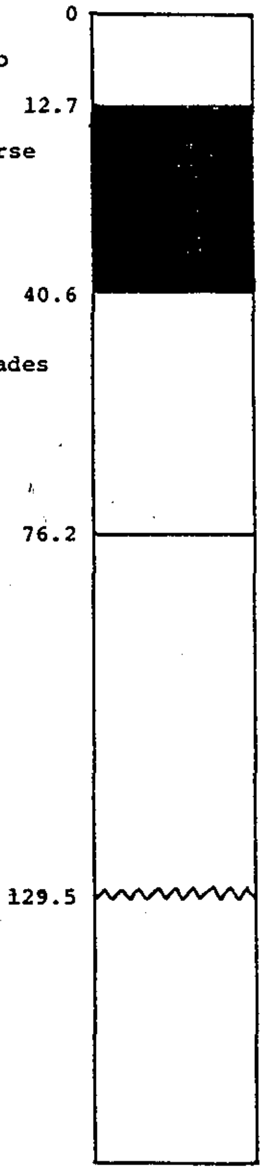
Diameter 6.5 cm

1 cm ≈ 8 cm of core

Darkened area indicates dredged material

FIGURE III-3-93

SEDIMENT CORES, FVP-100E,
July 1983



Field Log No. ______

Site FVP

Location 100 East

Date Sampled July 1983

Length of Core 129.5 cm

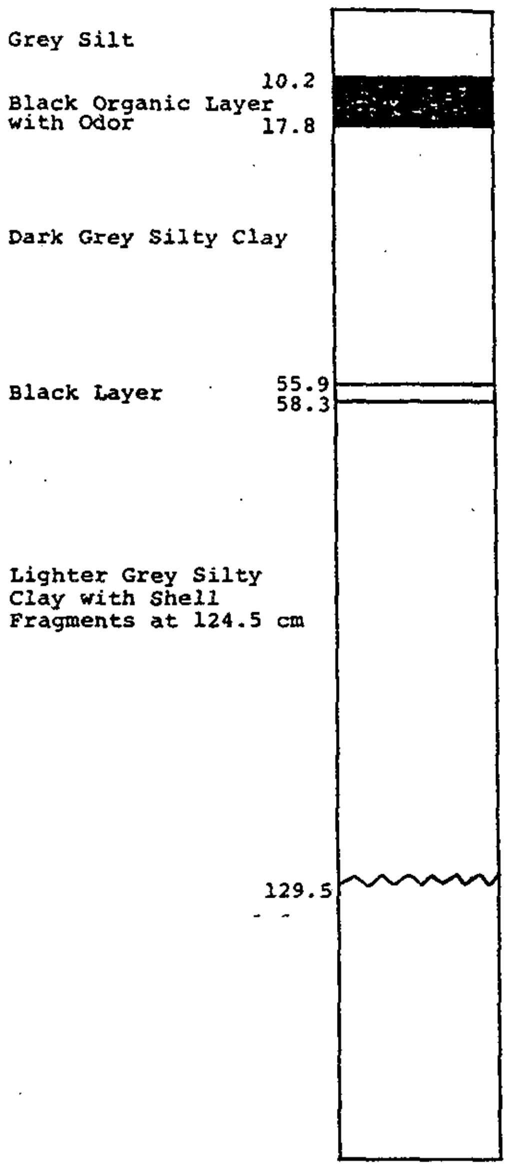
Diameter 6.5 cm

1 cm = 8 cm of core

Darkened area indicates
dredged material

FIGURE III-3-94

SEDIMENT CORES, FVP-100W,
July 1983



Field Log No. ________

Site FVP

Location 100 West

Date Sampled July 1983

Length of Core 129.5 cm

Diameter 6.5 cm

1 cm = 8 cm of core

Darkened area indicates dredged material.

FIGURE III-3-95

#38). The results of these studies are summarized below and in Table III-3-26.

There was considerable variability in the engineering properties of the sediment tested in this study, which reflects a heterogeneous sediment composition of the mound and possibly mixing of mound and natural bottom sediments during deposition. The mound sediments are primarily organic silts with variable sand and clay fractions. Sediment strengths are very low as a result of high water contents of the surface grab samples and, as a result, these fluid-like samples exhibited considerable disturbance, possible from sampling, handling and storage. The potential for compression (consolidation) is generally moderate to high with both mound and natural bottom sediments having about the same compression indices.

The coarse nature of the sediments near the center of the mound as compared to those at 200 and 400E indicate a winnowing of the finer sediments or their dispersion to the flanks of the mound on disposal. The density measurements compare well with those determined by the nuclear density probe. Work with the probe combined with other geotechnical measurements is ongoing at the FVP site.

TABLE III-3-26

GEOTECHNICAL PROPERTIES
OF
SEDIMENTS AT THE
FVP SITE

Sample	Desc.	Water Content W_n	Liquid Limit W_l	Plastic Limit W_p	Grain Size Sand/ Silt/ Clay (%)	Undr. Strength S_u (T/m^2)	Wet Mass (g/ml) Density	Organic Matter Content %	$s/\bar{\sigma}$ ratio	Compr. Index C_c	Swell Index C_s	Coef. Consol C (cm^2/min)
FVP 400E	Ol-qry silt with clay & some sand	119.4	92.8	40	5.3/70.1/24	.098	1.40	6.1	0.52	0.82	0.16	$5.5x10^{-2}$
FVP 200E	Blk silty sand (B.R.)	150.0	119.1	23	21.6/55.4/23		1.33					
	Ol-Gry clayey silt	104.0		44.2	2.6/68.4/29	.15	1.44					
FVP 100E	Blk Organic Silty Sand (B.R.)	125.9	60.1	52.1	63.8/24.2/12.	.064	1.38	7.8		0.75	0.125	$2.6x10^{-2}$
FVP 50E	Blk Silty Sand with some clay	117.5	71.1	33.9	44.1/37.9/18	.096	1.40					
FVP CTR	Silty Sand - some shells (B.R.)	99.5		36.4	63.6/22.4/14.	.11	1.45	7.4	0.40			
	Blk Silty - sand cap	62.8	56.9	22.8	57.6/32.4/10	N.A.	1.62	5.5				

APPENDIX III

APPENDIX III
TABLE 3-1

D.A.M.O.S. DIVER MONITORING LOG

DATE: 1 March 83 LOCATION: EPA central (to West 100 m on transect line) (43998.8/26535.0)

DIVERS: Stewart/ DeGoursey TIME: 1321-1345 DEPTH: 72' T°C: VISIBILITY: 1.5'

DIVE (in/out Loran C): DISPOSAL or REFERENCE BUOY (L/C:

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, nefflold layer, surface features (composition), shell hash (% cover), topography (slope/contour/apron), compaction, bioturbation, perimeter Loran C.

See attached page

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/ organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

Cancer irroratus (numerous) 15+
Cragnon (3) large
Pseudopleuronectes americanus (6) juvenile old < 10 cm.
Scopthalmus aquosus (2)
Pagurus longicarpus (5)
Nassarius trivittatus (20)
Asterias forbesi (7)
Homarus americanus (1)
Copepods (5)

II. DISCRETE SAMPLES OR METHODS:

X A. Epibenthic net (30 sec. traverse): on or off spoil, target species.

X B. .25 m^2 quadrant count/photography.

____ C. Penetrometer tests, elevation stake readings, sediment trap.

____ D. Mussel deployment - bioaccumulation subsample.

____ E. Sonic beacon placement or electrolyte change.

____ F. Remote bathymetric camera photos.

____ G. Video tape (location, time min. run, tape index).

____ H. Opportunistic collection (i.e. natural mussel bed, Corymorpha Axius.)

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL)

200 m transect line deployed E - W with station markers every 5 m numbered 1-40 from West to East. Stn. 17 located due south of EPA "L" buoy center weight.

Start ebb, .5 kt to east, no flocculent benthic veneer yet near bottom, suspended load reduced visibility to 1.5 ft. Sediment surface "pock marked" by C. irroratus excavation (1 every 2-3 m) (dimensions 10-15 cm diam x 5-7 cm deep), notable small Gemma or Nucula valves in these depressions creating an overall "dimpled" sediment terraine. Flat bottom with extensive bioturbation (described above) plus Ceriantheopsis tubes abundant with slight (1-2 cm) resilient mounds adjacent to sub-surface burrow tubes.

APPENDIX III
TABLE 3-2

D.A.M.O.S. DIVER MONITORING LOG

DATE: 4 March 83 LOCATION: EPA Black Rock Site - Baseline

DIVERS: Auster/ Buchholz TIME: 1027-1044 (17 min.) DEPTH: 72' T°C: VISIBILITY: 4'

DIVE (in/out Loran C): DISPOSAL or REFERENCE BUOY (L/C:

Transect Line Stn 15 - 38 Buoy "L"

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, neffloid layer, surface features (composition), shell hash (% cover), topography (slope/contour/apron), compaction, bioturbation, perimeter Loran C.

Current vel. ~.25 kt E to W.
Consolidated clay/silt with thin unconsolidated silt veneer.
Less than 1% shell hash cover (photo).
Continuous series of surface depressions probably caused by Cancer irroratus.
Topographic relief approximately .5 m

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/ organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

Cancer irroratus - 37 Tracks over all surfaces. Many sheltering along transect line. One sheltering along arms of Asterias forbesi (photo)
Asterias forbesi - 8 Slow moving. Sediment veneer on dorsel surface and well-formed sediment ripples around arms (photo).
Corymorpha pendula - 20 Patchy - 3/.25 m^2 max. (photo).
Cerianthus americanus - 3 (photo) Pagurus longicarpus - 5
Nassarius trivittatus - 10 3 cm conical burrow - 1

II. DISCRETE SAMPLES OR METHODS:

X A. Epibenthic net (30 sec. traverse): on or off spoil, target species. STN 35-38
X B. .25 m^2 quadrant count/photography: 15 frames
____ C. Penetrometer tests, elevation stake readings, sediment trap.
____ D. Mussel deployment - bioaccumulation subsample.
____ E. Sonic beacon placement or electrolyte change.
____ F. Remote bathymetric camera photos.
____ G. Video tape (location, time min. run, tape index).
____ H. Opportunistic collection (i.e. natural mussel bed, Corymorpha Axius.)

D.A.M.O.S. DIVER MONITORING LOG

DATE: 18 April 83 **LOCATION:** EPA/FVP Ctr to West along transect 50 m

DIVERS: Stewart/ Silvia **TIME:** 1452-1512 **DEPTH:** 74' **T°C:** 5°C **VISIBILITY:** 4' - 5'

DIVE (in/out Loran C): FVP/EPA Ctr 44000.0 26535.2

DISPOSAL or REFERENCE BUOY (L/C: down center "O" buoy - swim south to intercept transect line swim W toward "O" m mark flag.

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, neffloid layer, surface features (composition), shell hash (% cover), topography (slope/contour/ apron), compaction, bioturbation, perimeter Loran C.

Natural bottom with occasional (every 1-2 m) evidence of crab (C. irror.) excavation depressions, 4 verticle burrows (Squilla?) and one lobster (Homarus) burrow.

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/ organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

(10+) juvenile Pseudopleuronectes americanus/ (10-15 cm)	(3) Libinia
(100+) Nassarius trivittatus	(2) Urophysis sp. - hake (juv.)
(300+) Mysids	Corymorpha (7, 5, 2, 5/25 m2)
(5) Crangon	Yoldia - siphon venting evident
(4+) Cancer irroratus (adult)	
(20+) C. irror. - juvenile (< 5 cm)	(1) Homarus americanus
(15+) Pagurus longicarpus	

II. DISCRETE SAMPLES OR METHODS:

_X_ **A. Epibenthic net (30 sec. traverse):** ~~on/off spoil/target species:~~ at Stn. #14 to West, pressure wave escape reaction of Crangon & Mysids noted.

____ **B. .25 m² quadrant count/photography.**

____ **C. Penotrometer tests, elevation stake readings, sediment trap.**

____ **D. Mussel deployment - bioaccumulation subsample.**

____ **E. Sonic beacon placement or electrolyte change.**

____ **F. Remote bathymetric camera photos.**

____ **G. Video tape (location, time min. run, tape index).**

____ **H. Opportunistic collection (i.e. natural mussel bed, Corymorpha Axius.)**

*West leg transect line loop foul #19/#17 in ball w/i 1 m.

APPENDIX III
TABLE 3-4

L.A.M.O.S. DIVER MONITORING LOG

DATE: 18 May 83 LOCATION: FVP 250 m East - Dive #1, 500 m East - Dive #2

DIVERS: Stewart Moffat TIME: #1 - 1250-1307 #2 - 1319-1347 DEPTH: 70' T°C: VISIBILITY: 1.5'

DIVE (in/out Loran C): DISPOSAL or REFERENCE BUOY (L/C:

Dive #1 - Spot dive NW-N-E-SE (~ 100 m)
Dive #2 - Transect to west with flood tide
Natural bottom -- spoil evidence periphery

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, neffloid layer, surface features (composition), shell hash (% cover), topography (slope/contour/apron), compaction, bioturbation, perimeter Loran C.

#1 250 m E soft black spoil w/mm brown layer, leaf and wood surface debris. Start flood tide (.5 kt) 1.5 ft. vis., extremely soft spoil to depth 8-6" coverage over natural (lt. brown) bottom surface; small clay clump fragments, no large clay blocks noted.

#2 500 n E transect with tide, shallow benthic excavation depressions (crab) every 2-3 m, shell hash noted in depression holes, intercepted edge of spoil and followed periphery-spoil border - 26533.1/43999.7

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/ organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

#1 (1) Asterias, (2) Scopthalmus aquosus, (5) Pagurus longicarpus, (4-6) C. irrorata (3 directly adjacent to large boulder), (1) Pseudopleuronectes americanus numerous crab and lobster tracks, fin prints on spoil surface.

#2 Corymorpha (scarce, 10 sighted over total transect, (7) P. amer, (4) S. aquosus evidence of Corymorpha polyp lysis, (3) 1" diameter verticle burrows (Squilla?), (1) Urophysis

II. DISCRETE SAMPLES OR METHODS: (2) for 250 m E, and periphery location

X A. Epibenthic net (30 sec. traverse): on or off spoil, target species.

____ B. .25 m^2 quadrant count/photography.

____ C. Penotrometer tests, elevation stake readings, sediment trap.

____ D. Mussel deployment - bioaccumulation subsample.

____ E. Sonic beacon placement or electrolyte change.

____ F. Remote bathymetric camera photos.

____ G. Video tape (location, time min. run, tape index)..

____ H. Opportunistic collection (i.e. natural mussel bed, Corymorpha Axius.)

X Series of diver sediment profile photographs at 250 and 500 periphery locations. Also normal macrophotographs of benthos & surface sediment.

APPENDIX III
TABLE 3-5

D.A.M.O.S. DIVER MONITORING LOG

DATE: 25 May 83 LOCATION: FVP - North border

DIVERS: Stewart/ Buchholz TIME: 1159 } 1224 } 25 min DEPTH: 69' T°C: VISIBILITY: 3.5'

DIVE (in/out Loran C): DISPOSAL or REFERENCE BUOY (L/C:

In: 26535.7 44001.0 North FVP pile border 26535.4 44000.8

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, neffloid layer, surface features (composition), shell hash (% cover), topography (slope/contour/ apron), compaction, bioturbation, perimeter Loran C.

On natural bottom numerous siphon holes, venting noted, shell-laden depressions, soft 1-3 cm surface with compact sub interface sediment detected by diver hand probe. Intercept spoil overlay on SE transect course to point of 3 cm spoil overlay, reverse direction to NE to minimum detectable overlay (N 2-4 mm) 5 m band. Place surface marker and place 20 m (5 m station) border station N-S.

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/ organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

See attached page

II. DISCRETE SAMPLES OR METHODS:

X A. Epibenthic net (30 sec. traverse): on or off spoil, target species. at periphery N 10 m - transect 30 m to S

X B. .25 m^2 quadrant count/photography. Sediment profile photography. Photo frames 1-18 Cannon macro

___ C. Penotrometer tests, elevation stake readings, sediment trap.

___ D. Mussel deployment - bioaccumulation subsample.

___ E. Sonic beacon placement or electrolyte change.

___ F. Remote bathymetric camera photos.

___ G. Video tape (location, time min. run, tape index).

___ H. Opportunistic collection (i.e. natural mussel bed, Corymorpha Axius.)

TABLE 3-5 (cont)

B. (BIOLOGICAL) - etc.

No *Corymorpha*
Yoldia (venting) 10^+)
3-4 unidentified polychaetes excavated in sediment profile photos.
Neomysis sp.
Cancer irroratus (20^+)
Cragnon sp.
Squilla (verticle holes) (4)
Asterias forbesii (15)
Nassarius trivitattus (10)
Pagurus longicarpus "packs" 4-8 (20^+)
Scopthalmus aquosus (6^+)
Paralichthys oblongus - 4-spot flounder (1)
Pseudopleuronectes americanus - all less than 10 cm (4)
Fecal mounds prevalent

APPENDIX III
TABLE 3-6

D.A.M.O.S. DIVER MONITORING LOG

DATE: 25 May 83 LOCATION: FVP - Northeast border

DIVERS: Buchholz/ Stewart TIME: 1359 1421 DEPTH: 28' T°C: VISIBILITY: 1-2'

DIVE (in/out Loran C): DISPOSAL or REFERENCE BUOY (L/C:

44000.5/26534.0 → 44000.5/26533.2

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, nefloid layer, surface features (composition), shell hash (% cover), topography (slope/contour/ apron), compaction, bioturbation, perimeter Loran C.

Entered on natural bottom, high turbidity 2/1-2' visibility. Compact substrate w/1-2 cm suspended layer. Swam SE direction, encountered clay spoil material up to 2-3 cm. Reversed direction to areas of 2-3 mm thick spoil material. At perimeter, anchored surface marker for later surface fix.

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/ organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

No Corymorpha
Cancer irroratus (10^+)
Asterias forbesii (4) - 2 with regenerating appendages - predation
Pagurus longicarpus (2)
Nassarius trivittatus (10)
Neomysis

II. DISCRETE SAMPLES OR METHODS:

X A. Epibenthic net (30 sec. traverse): on or off spoil, target species.
X B. .25 m^2 quadrant count/photography.
____ C. Penetrometer tests, elevation stake readings, sediment trap.
____ D. Mussel deployment - bioaccumulation subsample.
____ E. Sonic beacon placement or electrolyte change.
____ F. Remote bathymetric camera photos.
____ G. Video tape (location, time min. run, tape index).
____ H. Opportunistic collection (i.e. natural mussel bed, Corymorpha Axius.)

APPENDIX III
TABLE 3-7

D.A.M.O.S. DIVER MONITORING LOG

DATE: 25 May 1983 LOCATION: FVP - SE area

DIVERS: Auster/ Moffat TIME: 1257 - 1317 DEPTH: 70' T°C: VISIBILITY: 3'

DIVE (in/out Loran C): DISPOSAL or REFERENCE BUOY (L/C:

In 43998.8/26535.2 Out 43998.5/26534.4 Border 43998.5/26534.4

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, nefflold layer, surface features (composition), shell hash (% cover), topography (slope/contour/ apron), compaction, bioturbation, perimeter Loran C.

Perimeter area - spoil veneer over natural bottom. ~ 2 mm oxidized surface layer over black spoil over yellow brown natural bottom. No irregular topography. Benthic fauna bioturbating surface (feeding, burrowing, tracking, etc.)

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/ organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

Asterias forbesii (many with missing arms) - 47 - *Mulina* shell hash around several individuals of Asterias
Cancer irroratus - 32 - Using *Asterias* for thigmotactic shelter response
Pseudopleuronectes americanus - 3
Raja erinacea - 1
Libinia emarginata - 1
Urophysis sp. - 1

II. DISCRETE SAMPLES OR METHODS:

_____ A. Epibenthic net (30 sec. traverse): on or off spoil, target species.

__X__ B. .25 m^2 quadrant count/photography.

_____ C. Penotrometer tests, elevation stake readings, sediment trap.

_____ D. Mussel deployment - bioaccumulation subsample.

_____ E. Sonic beacon placement or electrolyte change.

_____ F. Remote bathymetric camera photos.

_____ G. Video tape (location, time min. run, tape index).

_____ H. Opportunistic collection (i.e. natural mussel bed, *Corymorpha Axius*.)

X I. Station established 1-5 S - N

APPENDIX III
TABLE 3-8

D.A.M.O.S. DIVER MONITORING LOG

DATE: 25 May 83 LOCATION: FVP - Eastern border

DIVERS: Auster/ Moffat TIME: 1447-1506 DEPTH: 68' T°C: VISIBILITY: 3 ft

DIVE (in/out Loran C): DISPOSAL or REFERENCE BUOY (L/C:

In 43999.5/26533.2 Out 43999.0/26531.9 E border 43999.2/26532.6

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, nefflold layer, surface features (composition), shell hash (% cover), topography (slope/contour/ apron), compaction, bioturbation, perimeter Loran C. Cur. W → E .75 kt.

Topographically flat area. Patches of surface sediment depressions due to burrowing Cancer irroratus. Spoil border conditions same as previous dive with tapering spoil overlay. Natural bottom with patches of shell debris, average ~5% surface cover. Surface covered by decapod "dimple" tracks.

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/ organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

Cancer irroratus - 27
Libinia emarginata - 3
Scophthalmus aquosus - 2
Urophysis sp. - 1
Asterias forbesii - 15
Pagurus pollicaris - 1
Pagurus longicarpus - 6

1 - empty 30 cm diameter lobster burrow - 2 entrances U type

II. DISCRETE SAMPLES OR METHODS:

____ A. Epibenthic net (30 sec. traverse): on or off spoil, target species.

X B. .25 m^2 quadrant count/photography.

____ C. Penetrometer tests, elevation stake readings, sediment trap.

____ D. Mussel deployment - bioaccumulation subsample.

____ E. Sonic beacon placement or electrolyte change.

____ F. Remote bathymetric camera photos.

____ G. Video tape (location, time min. run, tape index).

____ H. Opportunistic collection (i.e. natural mussel bed, Corymorpha Axius.)

X I. Delineate spoil perimeter

APPENDIX III
TABLE 3-9

D.A.M.C.S. DIVER MONITORING LOG

DATE: 3 June 83 **LOCATION:** FVP SW border region

DIVERS: Auster/ Buchholz **TIME:** 1250-1315 **DEPTH:** 62 **T°C:** **VISIBILITY:** 4'

DIVE (in/out Loran C): **DISPOSAL or REFERENCE BUOY (L/C:**

In 43999.2/26536.4 SW border 43999.7/26537.0 Out 44000.0/26537.6

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, neffloid layer, surface features (composition), shell hash (% cover), topography (slope/contour/ apron), compaction, bioturbation, perimeter Loran C.

In position 4-5 cm spoil with .5 cm sediment overlay
Border position .5 cm spoil depth with areas of no spoil
Out position .2 - .5 cm spoil still present
Typical flat, featureless perimeter area. Some surface depressions due to Cancer burrowing and crab tracks ubiquitous

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/ organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

Cancer irrorates - 26 - pouring, burrowing surface depressions
Pseudopleuronectes americanus - 7
Scophthalmus aquosus - 1
Pagurus longicarpus - 35
Asterias forbesii - 3
Libinia emarginata - 2
Busycon canniliculatum - 1
3 - 6-10 cm dia vertical burrows
6 - 2-3 cm dia vertical burrows

II. DISCRETE SAMPLES OR METHODS:

____ **A. Epibenthic net (30 sec. traverse): on or off spoil, target species.**

_X_ **B. .25 m^2 quadrant count/photography.**

____ **C. Penotrometer tests, elevation stake readings, sediment trap.**

____ **D. Mussel deployment - bioaccumulation subsample.**

____ **E. Sonic beacon placement or electrolyte change.**

____ **F. Remote bathymetric camera photos.**

____ **G. Video tape (location, time min. run, tape index).**

____ **H. Opportunistic collection (i.e. natural mussel bed, Corymorpha Axius.)**

D.A.M.O.S. DIVER MONITORING LOG

DATE: 3 June 83 LOCATION: FVP site - E border transect station

DIVERS: Buchholz/ Auster TIME: 1134-1157 DEPTH: 66' T°C: VISIBILITY: 4'

DIVE (in/out Loran C): DISPOSAL or REFERENCE BUOY (L/C:

43999.2/26532.6 - center stake

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, nefflold layer, surface features (composition), shell hash (% cover), topography (slope/contour/apron), compaction, bioturbation, perimeter Loran C.

Deployed 100 m transect line w/center stake at 43999.2/26532.6
On spoil are stations 1-10, off spoil 10-20. Typical perimeter conditions, smooth surface texture, spoil depth only few millimeters (~ 3-5 mm). 0.5 - 1 cm layer of sediment over apparent spoil.

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/ organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

Crab tracks ubiquitous over all sediment surface
Cancer irroratus off spoil 17, on spoil 10
Scopthalmus aquosus - off 4, on 1
Pagurus longicarpus - on 15, off 15
Pseudopleuronectes americanus - 1 off spoil
Small mysids swarms - patchy to 10 cm above sediment

II. DISCRETE SAMPLES OR METHODS: (at either end of the deploy transect line.

2 A. Epibenthic net (30 sec. traverse): on or off spoil, target species.

____ B. .25 m^2 quadrant count/photography.

____ C. Penotrometer tests, elevation stake readings, sediment trap.

____ D. Mussel deployment - bioaccumulation subsample.

____ E. Sonic beacon placement or electrolyte change.

____ F. Remote bathymetric camera photos.

____ G. Video tape (location, time min. run, tape index).

____ H. Opportunistic collection (i.e. natural mussel bed, *Corymorpha Axius*.)

D.A.M.O.S. DIVER MONITORING LOG

DATE: 15 June 83 **LOCATION:** FVP East border

DIVERS: Buchholz/ Moffat **TIME:** 13:20-13:40 **DEPTH:** 70' **T°C:** **VISIBILITY:** 3'

DIVE (in/out Loran C): **DISPOSAL or REFERENCE BUOY (L/C:**

43999.2/26532.6 - mid 100 m E/W transect line — Buoy M

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, neffloid layer, surface features (composition), shell hash (% cover), topography (slope/contour/ apron), compaction, bioturbation, perimeter Loran C.

Current W 1 kt. Went down buoy M, swam 9-10 m, hit transect line at 13, spoil 2 cm thick, 2 mm thick at 14, no detectible units beyond 15. Swam 30 m E beyond end of line (20), took epibenthic on natural bottom. Topography: small washed-out clumps at 13; smooth and featureless from 14 on. Oxygenated top cm over entire transect. Substrate predominantly silt, no shell hash.

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/ organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

Cancer irroratus - $2/m^2$
Pagurus longicarpus - $12/m^2$
Pseudopleuronectes americanus - 3 5-20 cm
Hake 1 ~20-25 cm
Skate, *Raja erinacea* 1 ~30 cm

II. DISCRETE SAMPLES OR METHODS:

after station #20

X **A. Epibenthic net (30 sec. traverse): on or off spoil, target species.**
___ **B. .25 m^2 quadrant count/photography.**
___ **C. Penotrometer tests, elevation stake readings, sediment trap.**
___ **D. Mussel deployment - bioaccumulation subsample.**
___ **E. Sonic beacon placement or electrolyte change.**
___ **F. Remote bathymetric camera photos.**
___ **G. Video tape (location, time min. run, tape index).**
___ **H. Opportunistic collection (i.e. natural mussel bed, *Corymorpha Axius*.)**

D.A.M.O.S. DIVER MONITORING LOG

DATE: 15 June 83 LOCATION: FVP center - repositioned buoy "L"

DIVERS: Stewart/ Silvia TIME: 1227-1243 DEPTH: 67' T°C: VISIBILITY: 3'

DIVE (in/out Loran C): 43999.9/26535.4 transect to WSW

DISPOSAL or REFERENCE BUOY (L/C: Repositioned buoy "L" = FVP center

I. OBSERVATIONS:

A. **BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, neffloid layer, surface features (composition), shell hash (% cover), topography (slope/contour/ apron), compaction, bioturbation, perimeter Loran C.**

End flood W. Extremely soft black anoxic sediment with .5 cm oxygenated surface veneer. Evidence of Yoldia valves on surface of FVP spoil surface. At "L" buoy (center) .5 m of spoil-covered bottom; at a distance ~50 m W spoil depth was ~15-20 cm deep. Spoil sediment was extremely flat, without clay mounds or barge deposit contours evident, two small (20-30 cm) peat fragments were noted protruding from spoil surface.

B. **(BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/ organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).**

Cancer irroratus - (50^+) obvious spoil surface affinity
Pseudopleuronectes americanus (2)
Crangnon (4)
Polychaetes (3) out of burrows on spoil surfaces
Yoldia valves numerous (4 siphon ventings noted)

II. DISCRETE SAMPLES OR METHODS:

X A. **Epibenthic net (30 sec. traverse): on or off spoil, target species.** at 70 m W of FVP central

____ B. **.25 m^2 quadrant count/photography.**

____ C. **Penotrometer tests, elevation stake readings, sediment trap.**

____ D. **Mussel deployment - bioaccumulation subsample.**

____ E. **Sonic beacon placement or electrolyte change.**

____ F. **Remote bathymetric camera photos.**

____ G. **Video tape (location, time min. run, tape index).**

____ H. **Opportunistic collection (i.e. natural mussel bed, Corymorpha Axius.)**

D.A.M.O.S. DIVER MONITORING LOG

DATE: 17 June 83 **LOCATION:** FVP N border (check coordinates - questionable position and no spoil was observed during entire dive)

DIVERS: Moffat/ Buchholz **TIME:** 1006-1020 **DEPTH:** ~ 60' **T°C:** 58° **VISIBILITY:** 2-3'

DIVE (in/out Loran C): 26535.4/44000.8

DISPOSAL or REFERENCE BUOY (L/C: Dropped buoy 20 m due E, dove to bottom and scanned W for transect line

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, nefflold layer, surface features (composition), shell hash (% cover), topography (slope/contour/ apron), compaction, bioturbation, perimeter Loran C.

Natural bottom with no general topography except for bioturbations. Current W, ~ 1/2 kt, 1-2 mm neffloid layer, fine silty sediment w/no shell hash. Sediment could be dug by hand w/moderate effort. Buoy was towed w/stake so that 20 m transect line could be marked when found; no transect line found, therefore, buoy staked at epibenthic sample site.

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/ organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

Windowpane flounder (1)
Squid - 30 cm (1)
Cancer irroratus 3 cm carapace- 2/3 burried in sediment (2)
Pagurus longicarpus (~ 5/m^2)
Asterias forbesi (1)
Busycon caniculatum 6" long (1)

Polychaete tubes extending ~ 1/2 cm above sediment patchy distribution average 10 tubes per 1/4m^2

II. DISCRETE SAMPLES OR METHODS:

ran C:
000.7
534.8
l. Norte:
392 x
405 ´ Red
694 Green
4.8 Y

X **A. Epibenthic net (30 sec. traverse): on or off spoil, target species.**

X **B. .25 m^2 quadrant count/photography.**

____ **C. Penotrometer tests, elevation stake readings, sediment trap.**

____ **D. Mussel deployment - bioaccumulation subsample.**

____ **E. Sonic beacon placement or electrolyte change.**

____ **F. Remote bathymetric camera photos.**

____ **G. Video tape (location, time min. run, tape index)..**

____ **H. Opportunistic collection (i.e. natural mussel bed, Corymorpha Axius.)**

APPENDIX III
TABLE 3-14

D.A.M.O.S. DIVER MONITORING LOG

DATE: 22 June 83 **LOCATION:** FVP site, N. side

DIVERS: Moffat/ Buchholz **TIME:** 13-5-1320 **DEPTH:** 75' **T°C:** **VISIBILITY:** 3.5'

DIVE (in/out Loran C): **DISPOSAL or REFERENCE BUOY (L/C:**

44000.9/26535.4 44000.9/26534.6

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, neffloid layer, surface features (composition), shell hash (% cover), topography (slope/contour/ apron), compaction, bioturbation, perimeter Loran C.

Current 1 kt^{+}; E. Clay/silt top 1 cm flocculent, oxidized. Below that, spoil entered over spoil ~ 3^{+} cm thick. Traveled E ~ 50^{+} yds. Found spoil getting thicker. Turned NE 100 - 150 m. At that time determined might be at perimeter of spoil w/ ~ 1 cm of spoil. Anchored buoy. After retrieving pipe anchor for buoy, extruded sed. core, found 3^{+} cm of spoil material.

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/ organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

Lost epibenthic net. Saw:

Pseudopleuronectes (5) (10-15 cm) in depressions with their topside flush with sed. surface.
Nassarius trivittatus (3)
Pagurus longicarpus (10)

II. DISCRETE SAMPLES OR METHODS:

_____ **A. Epibenthic net (30 sec. traverse): on or off spoil, target species.**

_____ **B. .25 m^{2} quadrant count/photography.**

_____ **C. Penotrometer tests, elevation stake readings, sediment trap.**

_____ **D. Mussel deployment - bioaccumulation subsample.**

_____ **E. Sonic beacon placement or electrolyte change.**

_____ **F. Remote bathymetric camera photos.**

_____ **G. Video tape (location, time min. run, tape index).**

_____ **H. Opportunistic collection (i.e. natural mussel bed, Corymorpha Axius.)**

APPENDIX III
TABLE 3-15

D.A.M.O.S. DIVER MONITORING LOG

DATE: 15 July 83 **LOCATION:** FVP East 400 m - diver transect line

DIVERS: Stewart **TIME:** 1011-1026 (19 min.) **DEPTH:** 65' slack ebb **T°C:** ~60° **VISIBILITY:** 6+ ft.

DIVE (in/out Loran C):

In 26532.6
43999.3 Swam S to Stn. #7

DISPOSAL or REFERENCE BUOY (L/C:

Apparent M buoy., EPA mussel station
Located 50 ft N of Stn 7-10 off transect line

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, nefflold layer, surface features (composition), shell hash (% cover), topography (slope/contour/ apron), compaction, bioturbation, perimeter Loran C.

End of ebb, to east, extremely low turbidity (3 days NW wind). No visible nefflold layer. 1 m stake placed 1 m North of Stn. #10 stake anchor. East end transect straightened toward N and tightened ~3 m to remove E leg slack. E transect end buoyed for Loran C fix - 26532.2/43998.9: 4" x 4" cement block to south of Stn. #4. Spoil depth excavation: #1 no spoil detected, #3 0.5 cm, #4 2mm oxidized sed. 1 cm spoil, below: natural grey sediment, #9 no spoil detected, #10 natural

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/ organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

Scopthalmus aquosus (3) (1-3 cm juv.)
Cerianthus americanus (5)
Nassarius trivittatus (100+)
Pagurus longicarpus (100+)
P. pollicaris (6)
Pseudopleuronectes americanus (12+)
(all juv., < 15 cm)

Busycon canaliculatum (1)
Crangon (4)
squid egg case - hatch out
(2) vertical 2 cm dia. burrows
(3) lobster burrows

II. DISCRETE SAMPLES OR METHODS:

_____ **A. Epibenthic net (30 sec. traverse): on or off spoil, target species.**

_____ **B. .25 m^2 quadrant count/photography.**

_____ **C. Penotrometer tests, elevation stake readings, sediment trap.**

_____ **D. Mussel deployment - bioaccumulation subsample.**

_____ **E. Sonic beacon placement or electrolyte change.**

_____ **F. Remote bathymetric camera photos.**

_____ **G. Video tape (location, time min. run, tape index)..**

_____ **H. Opportunistic collection (i.e. natural mussel bed, Corymorpha Axius.)**

APPENDIX III
TABLE 3-16

D.A.M.O.S. DIVER MC ITORING LOG

DATE: 15 July 83 LOCATION: FVP WSW sector

DIVERS: Buchholz/ Moffat TIME: 1159-1217 (18 min.) DEPTH: 66' T°C: ~60° VISIBILITY: 3-4 ft.

DIVE (in/out Loran C): DISPOSAL or REFERENCE BUOY (L/C:

43999.5/26536.1 43999.2/26537.3
~ border

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, nefflold layer, surface features (composition), shell hash (% cover), topography (slope/contour/ apron), compaction, bioturbation, perimeter Loran C.

Bottom current 1/2 kt. W, visibility 3-4". Fine light tan silt bioturbated to 2-3cm, 2 mm nefflold layer, no surface features < 1% shell hash. Top 2-3 cm easily scooped by hand, below 3 cm, cohesive clay. Ran transect SW to determine border area. Buoyed border, but spoil still appeared in patchy areas. Detected slight 1/2 m rise toward end of transect - possible barge dump.

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/ organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

No observed biology, except one small (4 cm) Asterias forbesii which entered the epibenthic sample taken ~ SW of buoy Loran coordinates.

II. DISCRETE SAMPLES OR METHODS:

X A. Epibenthic net (30 sec. traverse): on or off spoil, target species.

____ B. .25 m^2 quadrant count/photography.

____ C. Penotrometer tests, elevation stake readings, sediment trap.

____ D. Mussel deployment - bioaccumulation subsample.

____ E. Sonic beacon placement or electrolyte change.

____ F. Remote bathymetric camera photos.

____ G. Video tape (location, time min. run, tape index)..

____ H. Opportunistic collection (i.e. natural mussel bed, Corymorpha Axius.)

D.A.M.O.S. DIVER MONITORING LOG

DATE: 15 July 83 **LOCATION:** South of center FVP

DIVERS: Buchholz/ Moffat **TIME:** 1251-1314 (22 min.) **DEPTH:** 69" **T°C:** ~60°F **VISIBILITY:** < 2'

DIVE (in/out Loran C): **DISPOSAL or REFERENCE BUOY (L/C:**

43998.2/26535.2 ⟶ 26535.2/43997.8

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, neffloid layer, surface features (composition), shell hash (% cover), topography (slope/contour/ apron), compaction, bioturbation, perimeter Loran C.

Bottom current ~ 1 kt W, fine silt over ~ 2 cm of silt/clay spoil. No topography, shell hash < 1%. Bioturbation to 2 - 3 cm. Swam due south to locate border of spoil. Had trouble towing buoy so final coordinate is still over spoil.

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/ organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

Asterias forbesii - averaged 6-8/m^2, site range 4-8 cm dia. No feeding evident and all smaller ones were being swept across the sediment surface by the surrent
Pagurus longicarpus (3)
Libinia - shell - deceased?
Homarus americanus - claw only

II. DISCRETE SAMPLES OR METHODS:

_____ **A. Epibenthic net (30 sec. traverse): on or off spoil, target species.**

_____ **B. .25 m^2 quadrant count/photography.**

_____ **C. Penotrometer tests, elevation stake readings, sediment trap.**

_____ **D. Mussel deployment - bioaccumulation subsample.**

_____ **E. Sonic beacon placement or electrolyte change.**

_____ **F. Remote bathymetric camera photos.**

_____ **G. Video tape (location, time min. run, tape index).**

_____ **H. Opportunistic collection (i.e. natural mussel bed, *Corymorpha Axius*.)**

APPENDIX III
TABLE 3-18

D.A.M.O.S. DIVER MONITORING LOG

DATE: 30 August 83 **LOCATION:** FVP, South Border

DIVERS: Moffat/ Buchholz **TIME:** 10:33-10:50 **DEPTH:** 58' **T°C:** 20°C **VISIBILITY:** 2 1/2'

DIVE (in/out Loran C): **DISPOSAL or REFERENCE BUOY (L/C:** L

In - 43999.8/26535.3 Out - 43999.5/26535.8

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, nefflold layer, surface features (composition), shell hash (% cover), topography (slope/contour/ apron), compaction, bioturbation, perimeter Loran C.

Current < 1/4 kt, flood silt/silt-clay; start of dive, top 1 cm oxidized, black below that; 2 cm at end of dive. Neffloid < 1 mm surface largely featureless, some lumps of cohesive clay sed. ($\sim_2$6 during whole dive, dia. 10-30 cm). 2-3 patches of shell hash 1 m^2 topog. flat, featureless except for clay lumps. No perceptible general slope. Compaction easily scooped away by hand.

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/ organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

24 spot flatfish, both juv.
~5 windowpanes
~5 winter flounder
Pagurus longicarpus 2/1/4m^2
~8 Asterias
Shrimps - Crangon 1" long, 10/1/4m^2

1 lobster burrow, 7 cm dia.
1 lge. polyp, maroon color, 1" dia. to tentacled head, inside vertical burrows
1 Busycon canaliculatum
5 Cancer irroratus, juv. 2 cm
3 Pagurus pollicarus
2 Tautogolabrus adspersus

II. DISCRETE SAMPLES OR METHODS:

X **A. Epibenthic net (30 sec. traverse): on or off spoil, target species.**

X **B. .25 m^2 quadrant count/photography.** Nikonos, frames 19-36

____ **C. Penotrometer tests, elevation stake readings, sediment trap.**

____ **D. Mussel deployment - bioaccumulation subsample.**

____ **E. Sonic beacon placement or electrolyte change.**

____ **F. Remote bathymetric camera photos.**

____ **G. Video tape (location, time min. run, tape index).**

____ **H. Opportunistic collection (i.e. natural mussel bed, Corymorpha Axius.)**

APPENDIX III
TABLE 3-19

D.A.M.O.S. DIVER MONITORING LOG

DATE: 31 August'83 **LOCATION:** FVP "O" Central L Buoy

DIVERS: Stewart/ Bayreuther **TIME:** 1120-1129 **DEPTH:** 62' **T°C:** 20 **VISIBILITY:** 2'

DIVE (in/out Loran C):

DISPOSAL or REFERENCE BUOY L/C:
L Buoy mussel cages → S ~ 50 m
Photos and sediment profiles and benthos.

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, nefflold layer, surface features (composition), shell hash (% cover), topography (slope/contour/ apron), compaction, bioturbation, perimeter Loran C.

Sediment soft and uncompact (i.e. ease of diver penetration .75 m+)
Definite 1-2 cm light brown mobil surface veneer; underlaid with mixed coarse-silt black anoxic spoil; one diver excavation could not locate natural bottom 1 m+. Patch areas (5-10 cm diam) of coarse gravel to S of L buoy.
Debris wood pipes, peat material occasionally on surface (~2% coverage)
Decapod excavations approximately (12) over transect survey.

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

Pagurus longicarpus (20+)
Prionotus carolinus pectoral & pelvic fin manipulation
Cancer irroratus (4) juveniles (6)
Nassarius trivatattus (10)
Cerianthus americanus (1) extending from sediment
Busycon canniculatum (1)
Pseudopleuronectes americanus (1)

Fewer epibenthic fauna (i.e. 50% less) than observed at 400 m E.

II. DISCRETE SAMPLES OR METHODS:

____ **A. Epibenthic net (30 sec. traverse): on or off spoil, target species**

X **B. .25 m^2 quadrant count/photography.**

____ **C. Penetrometer tests, elevation stake readings, sediment trap.**

____ **D. Mussel deployment - bioaccumulation subsample.**

____ **E. Sonic beacon placement or electrolyte change.**

____ **F. Remote bathymetric camera photos.**

____ **G. Video tape (location, time min. run, tape index).**

____ **H. Opportunistic collection (i.e. natural mussel bed, Corymorpha Axius).**

(over)

APPENDIX III
TABLE 3-20

D.A.M.O.S. DIVER MONITORING LOG

DATE: 31 August LOCATION: FVP (400 m E) M buoy

DIVERS: Stewart/ Bayreuther TIME: 1045-1101 DEPTH: 66' T°C: 20° VISIBILITY: 2'

DIVE (in/out Loran C): 26532.6/43999.4

DISPOSAL or REFERENCE BUOY L/C: M buoy mussel cages S 10 m to transect line Photo traverse to E to end line then to SE.

I. OBSERVATIONS:

A. BENTHIC CONDITIONS (PHYSICAL) - Bottom current vel. and direction, turbidity, sediment grain size, neffloid layer, surface features (composition), shell hash (% cover), topography (slope/contour/ apron), compaction, bioturbation, perimeter Loran C.

At M buoy base oxgenated 1 cm surface layer; underlaid by 1-2 cm black spoil layer; with base gray silt/clay of natural bottom. Much evidence of bioturbation: verticle burrows, shell excavation patches, burrowed decapods and benthic finfish. Cluster concentrations of small bivalve 5% total surface coverage.

B. (BIOLOGICAL) - Diver species count, densities (est. no.) photo log nos., spoil/organism dynamics, behavior, transect observations (on/off) difference, biogenic sediment structures (burrows, tubes, tracks, casts, etc.).

Pagurus longicarpus (20+)
P. bernhardus (5)
Paralichthys
Gemma, Mulinia (100+)
(valves in decapod or Asterias excavation patches)
Libinia (1)
Totogalabrus adspersus (2)

Cerianthus americanus (6)+ 15 verticle burrows vacant.
Cancer irroratus (8)
Crangnon (4) + Dandalid (1)
Mytilus valves dead (1) cluster
Pseudopleuronectes americanus 10cm (3)
Loligo-squid egg cases on transett.

II. DISCRETE SAMPLES OR METHODS:

_____ A. Epibenthic net (30 sec. traverse): on or off spoil, target specie:

X B. .25 m^2 quadrant count/photography

_____ C. Penetrometer tests, elevation stake readings, sediment trap.

_____ D. Mussel deployment - bioaccumulation subsample.

_____ E. Sonic beacon placement or electrolyte change.

_____ F. Remote bathymetric camera photos.

_____ G. Video tape (location, time min. run, tape iudex).

_____ H. Opportunistic collection (i.e. natural mussel bed, Corymorpha Axius).

(over)

APPENDIX III

PLATES 3-1 to 3-42

SAIC

Plate 3-1. CLIS - FVP 1 March 1983 - baseline
Shell fragments in the base of a shallow depression (5-7 cm deep, 10-15 cm diameter) as evidence of feeding excavation by Cancer irroratus.

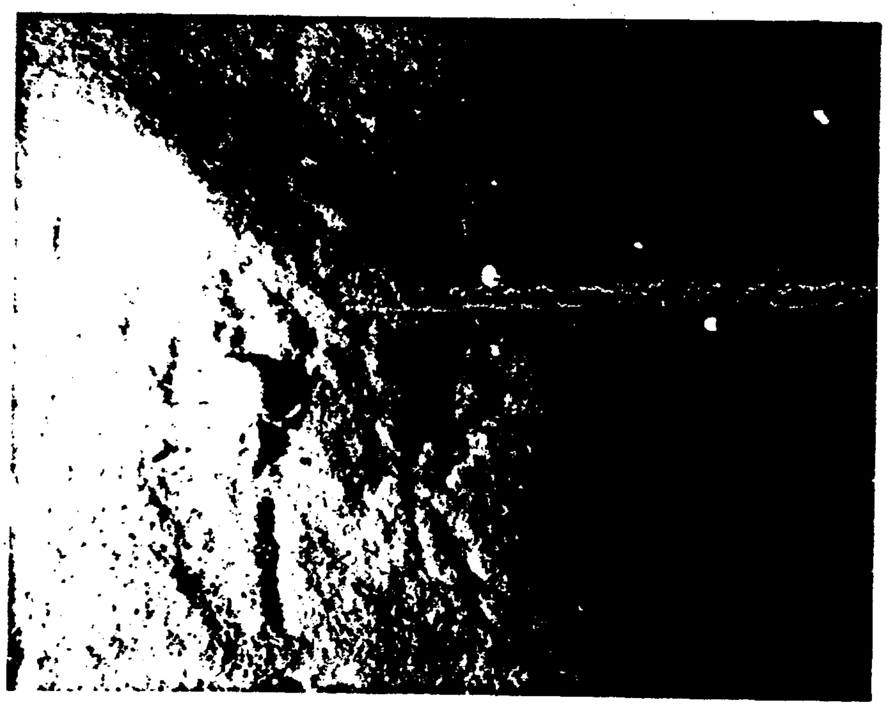


Plate 3-2. CLIS - FVP 1 March 1983 - baseline
Pagurus longicarpus tracking the flocculent sediment surface near a recent crustacean excavation.

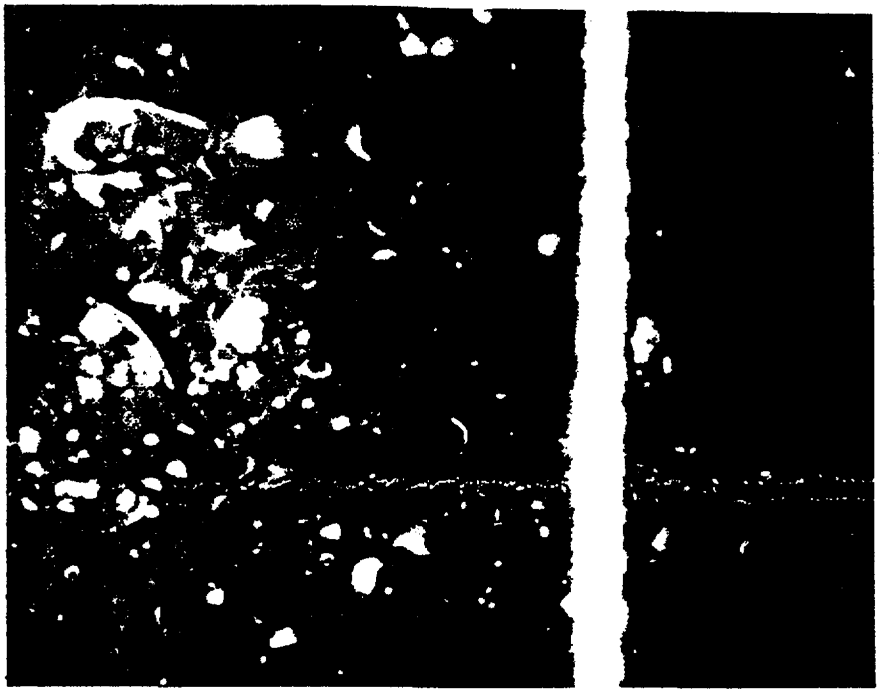


Plate 3-3. CLIS - FVP 1 March 1983 - baseline
An area of high concentration of bivalve shell fragments in the sediment, along the western half of the 200 m transect line.

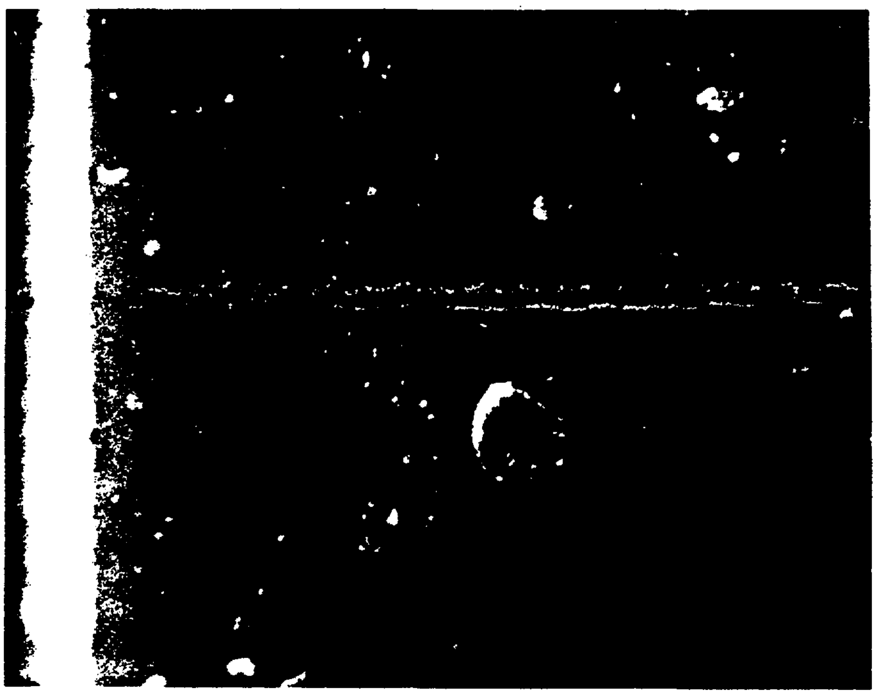


Plate 3-4. CLIS - FVP 1 March 1983 - baseline
Shell fragments and fecal mounds from sediment infauna along the western half of the transect line.

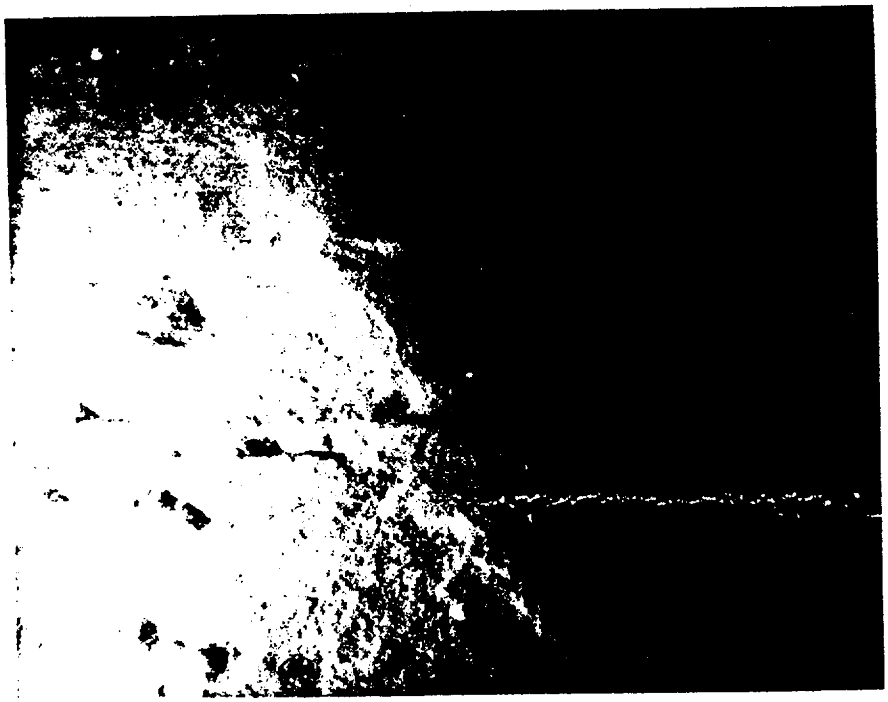


Plate 3-5. CLIS - FVP 1 March 1983 - baseline
Decapod tracks as evidence of bioerosion along the edge of a shallow (< 0.5 m) depression.

Plate 3-6. CLIS - FVP 1 March 1983 - baseline
Pseudopleuronectes americanus partially buried in soft sediment with a Ceriantheopsis americanus anemone in the background.

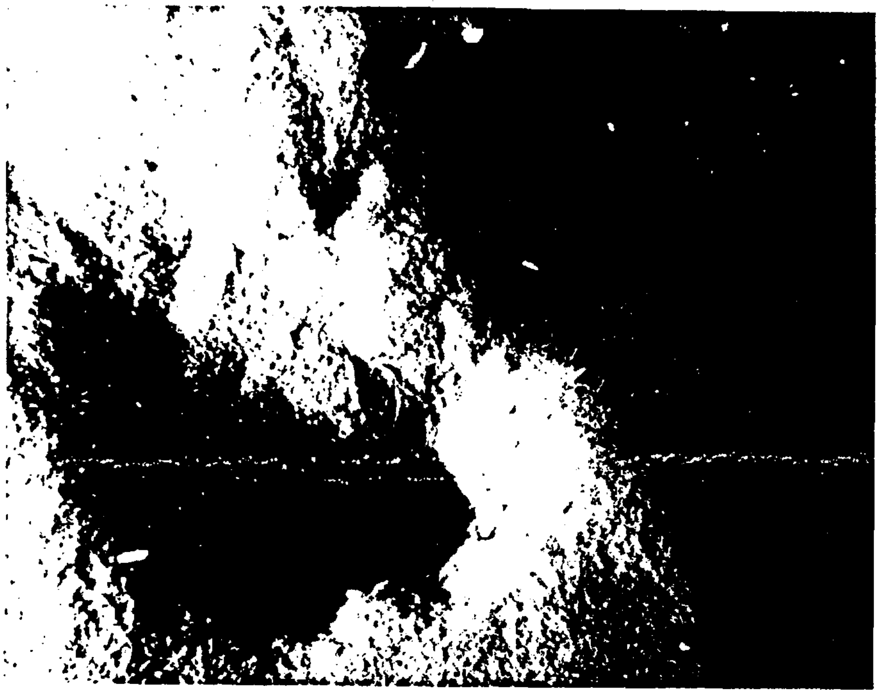


Plate 3-7. CLIS - FVP 1 March 1983
Two shallow depressions, 10-15 cm by 5-7 cm deep, created by the feeding activity of Cancer irroratus.

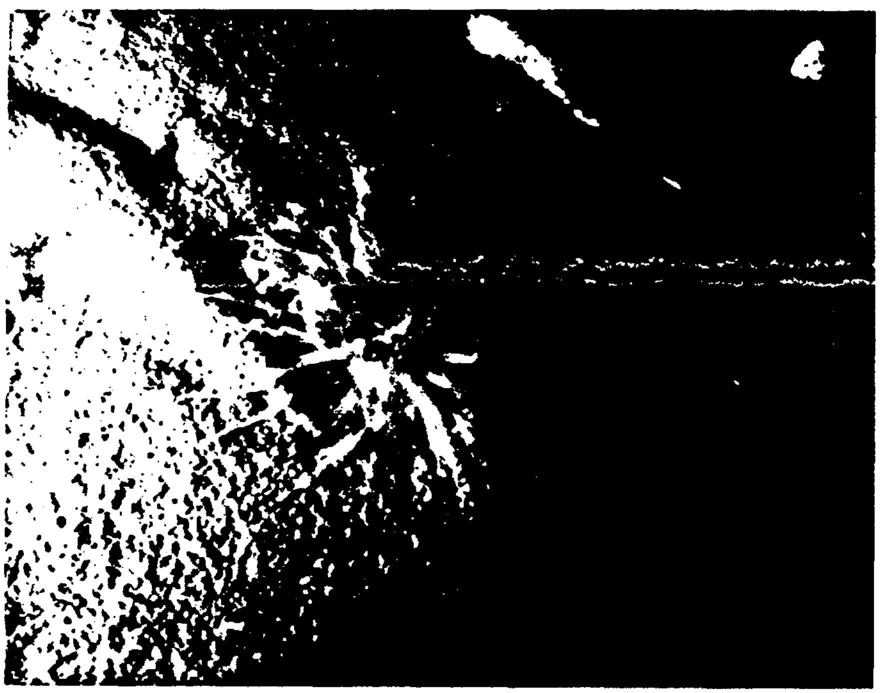


Plate 3-8. CLIS - FVP 1 March 1983 - baseline
Ceriantheopsis americanus anemone in the typical position of burial in soft sediment almost up to its tentacle whorl.

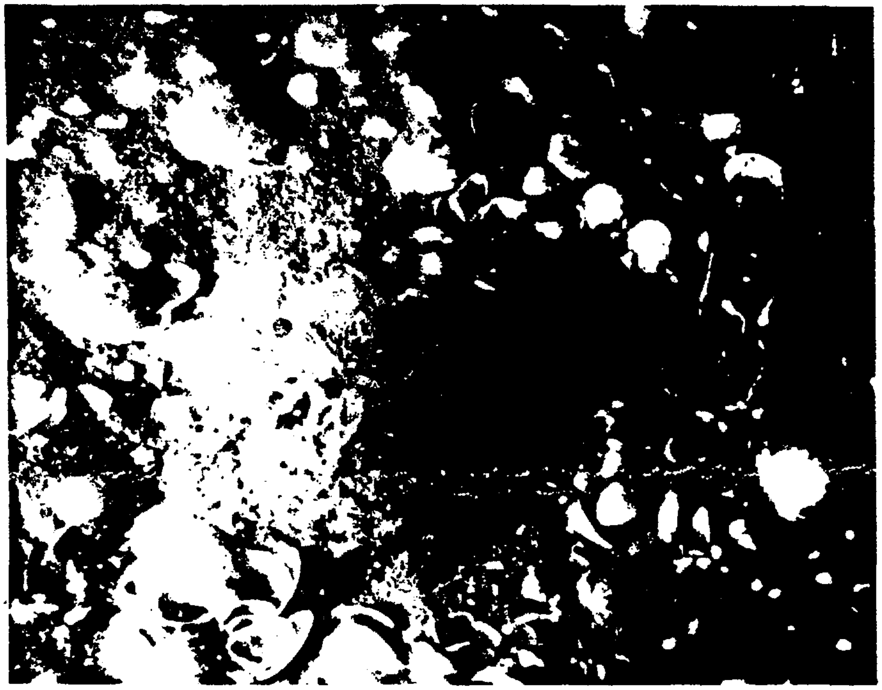


Plate 3-9. CLIS - FVP 1 March 1983 - baseline
Ceriantheopsis americanus anemone in an atypical position with a 2 cm mound of sediment at the base of its stalk in an area of high shell fragment litter.

Plate 3-10. CLIS - FVP 1 March 1983 - baseline
Nassarius trivittatus feeding on the sediment surface between Ceriantheopsis americana and Cormorpha pendula.

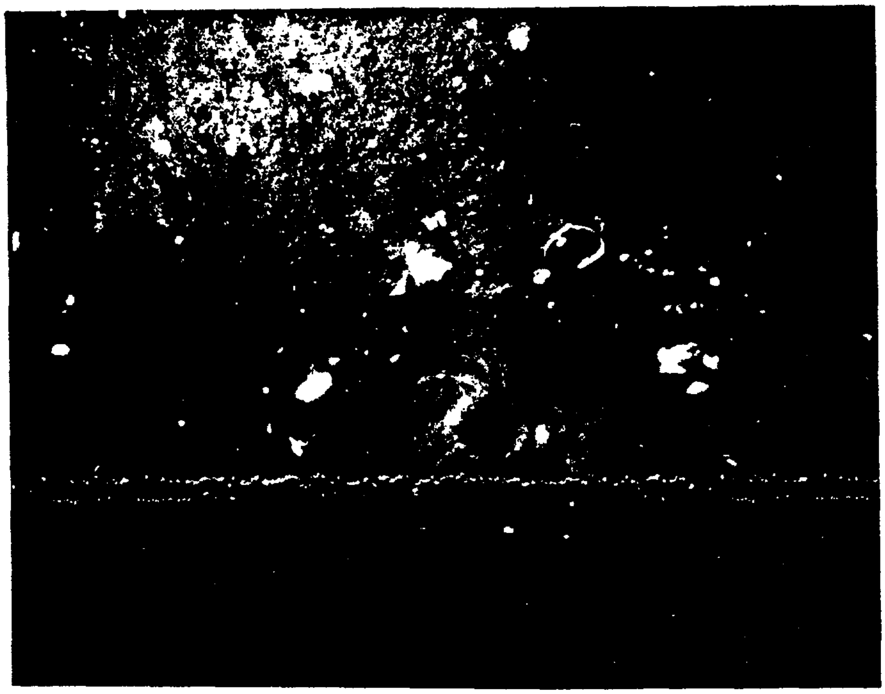


Plate 3-11. CLIS - FVP 4 March 1983 - baseline
Cerianthus borealis in soft sediment of less than 1% shell hash.

Plate 3-12. CLIS - FVP 4 March 1983 - baseline
Cancer irroratus under the eastern half of the 200 m transect line.

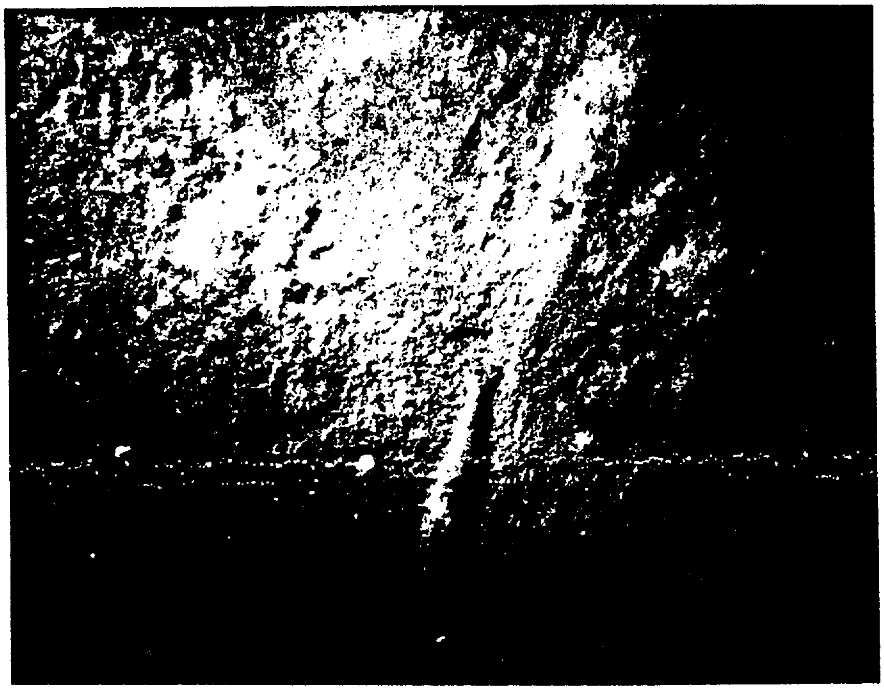


Plate 3-13. CLIS - FVP 4 March 1983 - baseline
A large Crangon septemspinosa on consolidated silt/clay sediment.

Plate 3-14. CLIS - FVP 4 March 1983 - baseline
An Asterias forbesi tracking over consolidated substrate with incorporated shell hash.

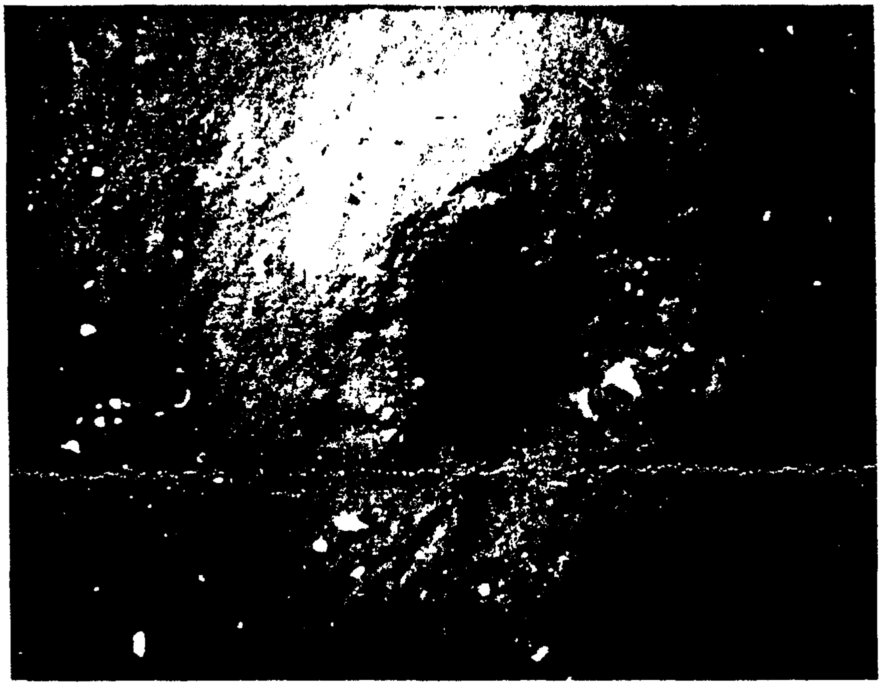


Plate 3-15. CLIS - FVP 4 March 1983 - baseline
A vertical 3-4 cm diameter burrow in consolidate silt/ clay substrate, possibly constructed by the mantis shrimp *Squilla empusa*.

Plate 3-16. FVP - Baseline, 18 April 1983
A juvenile *Pseudopleuronectes americanus* on natural bottom. Note tracks of decapod crustacea in the soft cohesive sediment, characteristic of this area.

Plate 3-17. FVP - Baseline, 18 April 1983
The common starfish, Asterias forbesi on natural sediment of 5% surface shell hash.

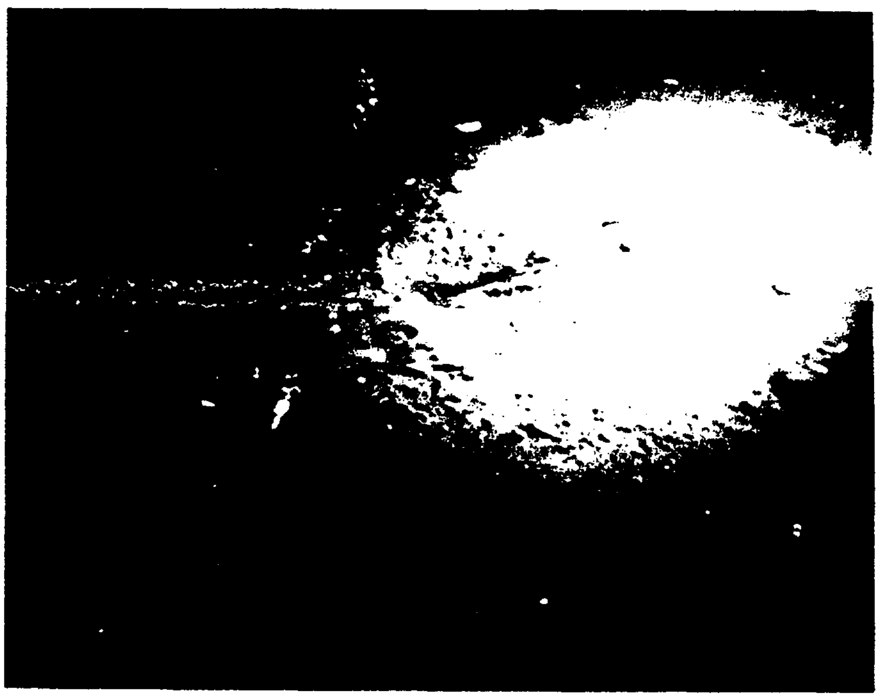


Plate 3-18. FVP - Baseline, 18 April 1983
Corymorpha pendula with developing gonotheca in the background and a juvenile Cancer irroratus in a feeding excavation in the foreground. Note the polychaete fecal casts on the surface of the sediment.

Plate 3-19. FVP - Baseline, 18 April 1983
Corymorpha pendula in its feeding position, facing into a moderate current flow. Decapod and gastropod tracks are evident over the sediment surface.

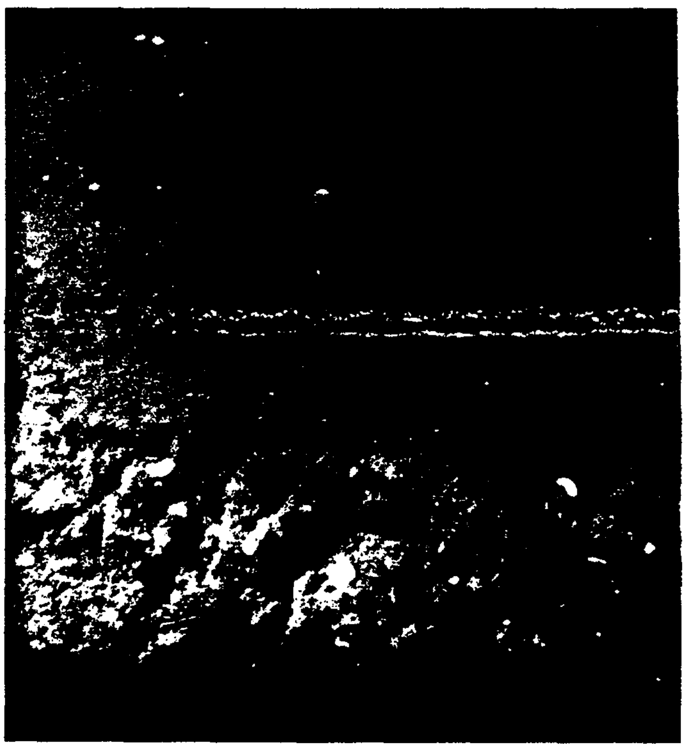


Plate 3-20. FVP - post-disposal, 25 May 1983
Sediment profiles after a diver's hand excavation showing the striation of dredge material over natural sediment.

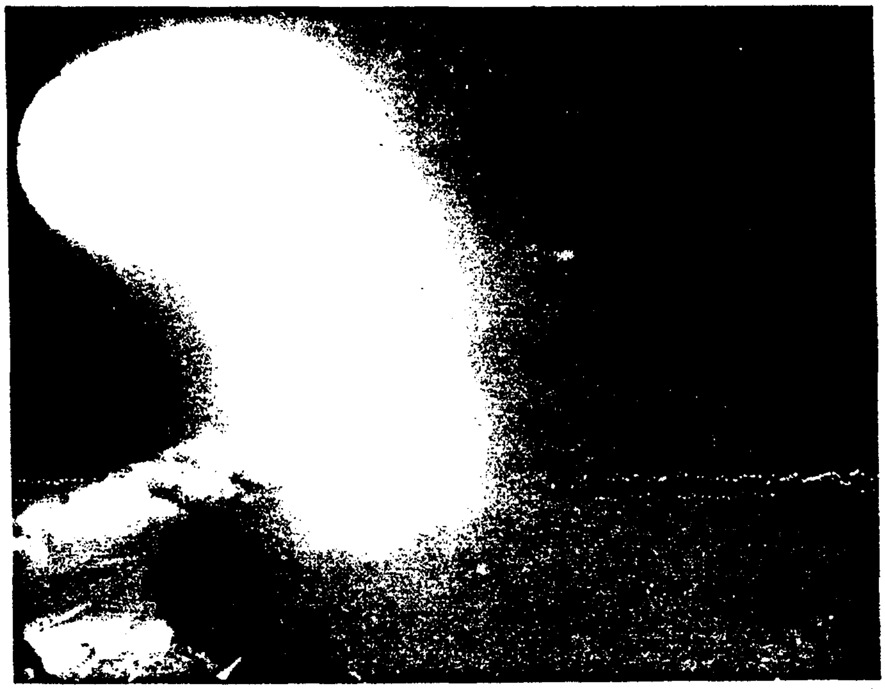


Plate 3-21. FVP - post-disposal, 25 May 1983
Photograph of the northern PVC pipe anchor of the 20 m transect line across the northern perimeter of the dredge material.

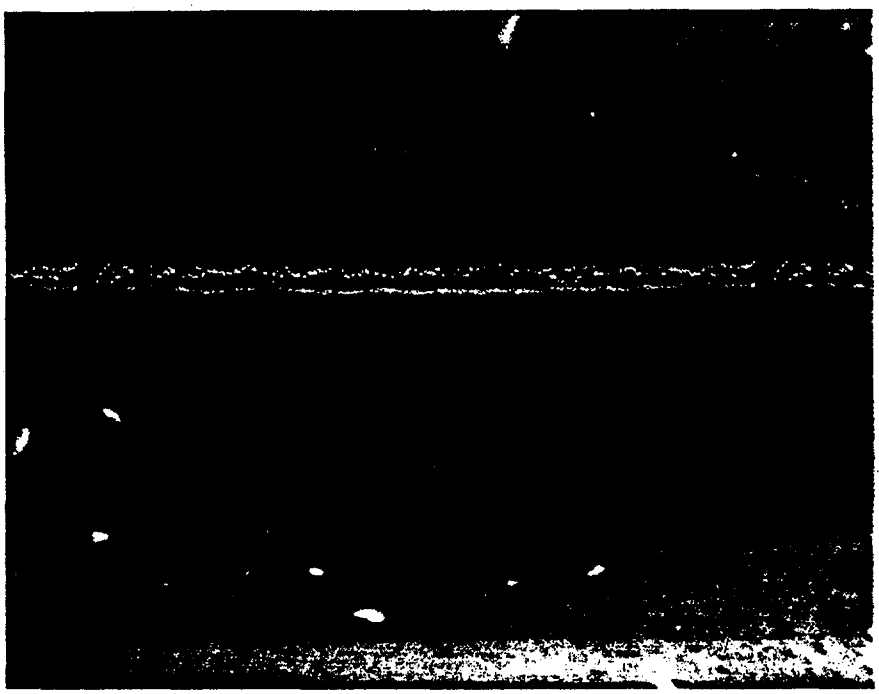


Plate 3-22. FVP - post-disposal, 25 May 1983
A small 3-4 cm diameter vertical burrow, possibly constructed by mantis shrimp *Squilla empusa*.

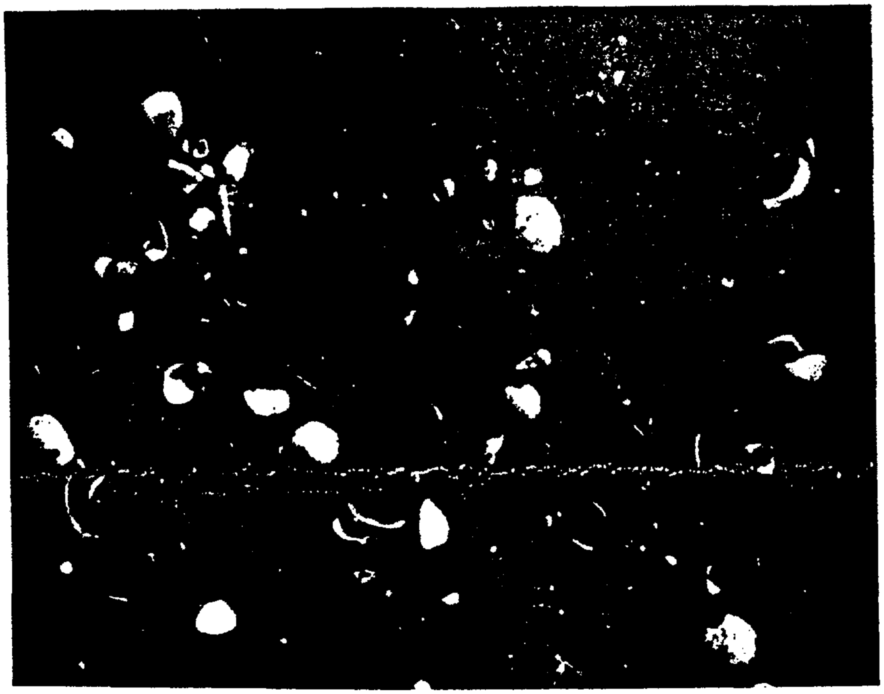


Plate 3-23. FVP - post-disposal, 25 May 1983
Shell hash and fecal trails on the sediment surface as evidence of epifaunal predation on the bivalve communities.

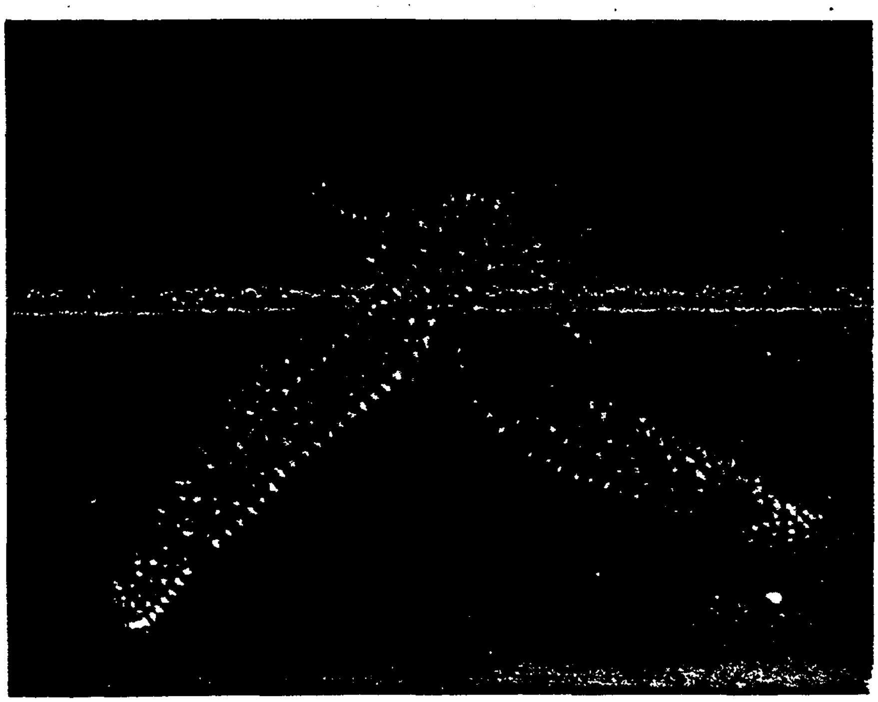


Plate 3-24. FVP - post-disposal, 25 May 1983
Asterias forbesi tracking the northern border of the dredge material. Note the flocculent sediment that has settled on the dorsal surface of the starfish.

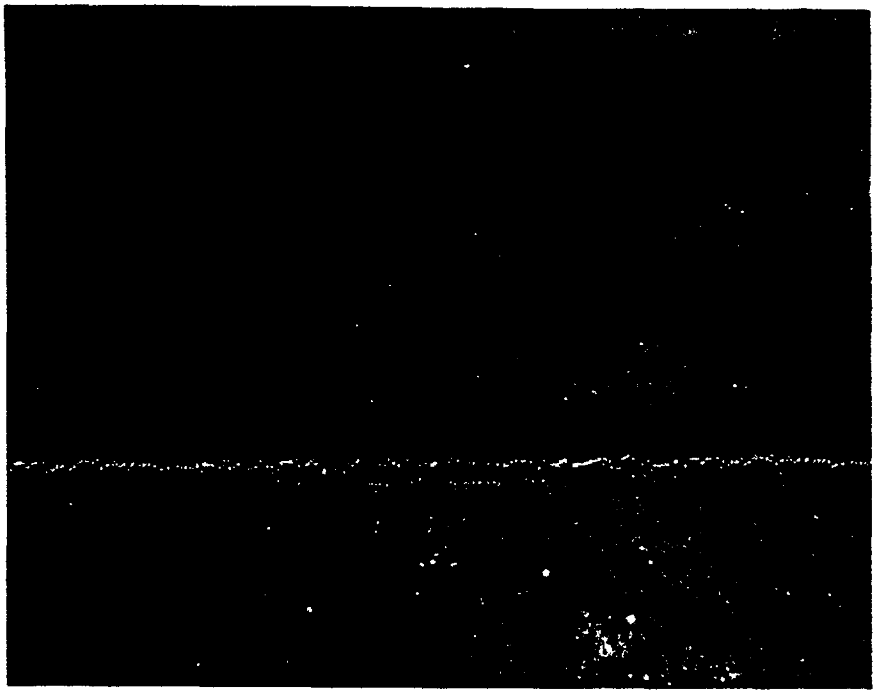


Plate 3-25. FVP - post-disposal, 25 May 1983
Bioturbation as evidenced from decapod tracks and polychaete fecal mounds on the surface of the sediment.

Plate 3-26. FVP - post-disposal, 25 May 1983
Bioturbation as evidenced from the foraging activities of the mud snail Nassarius trivittatus.

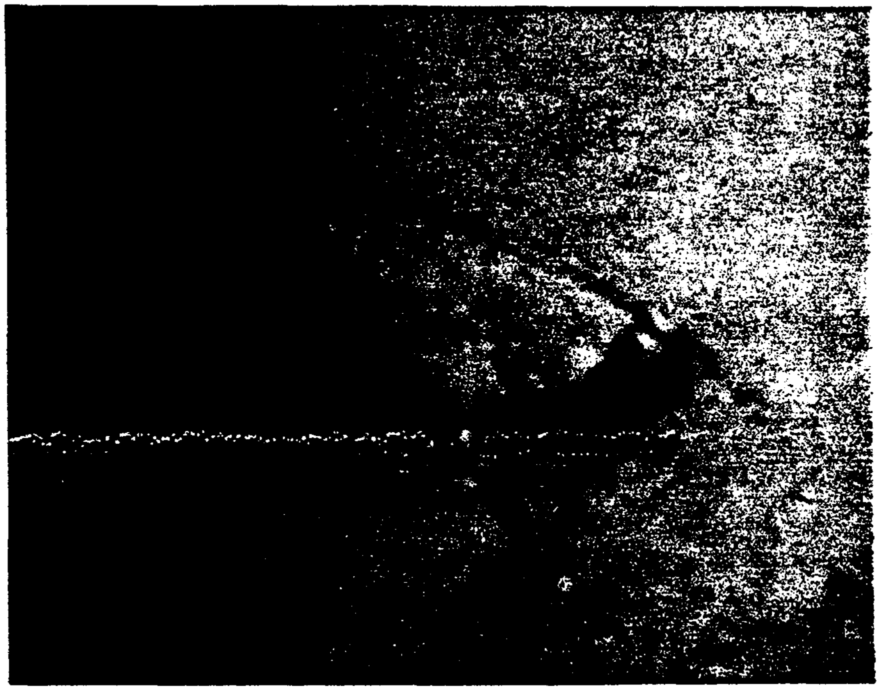


Plate 3-27. FVP - post-disposal, 25 May 1983
The four spotted flounder, Paralichtys oblongus partially buried at the northern border of the dredged material.

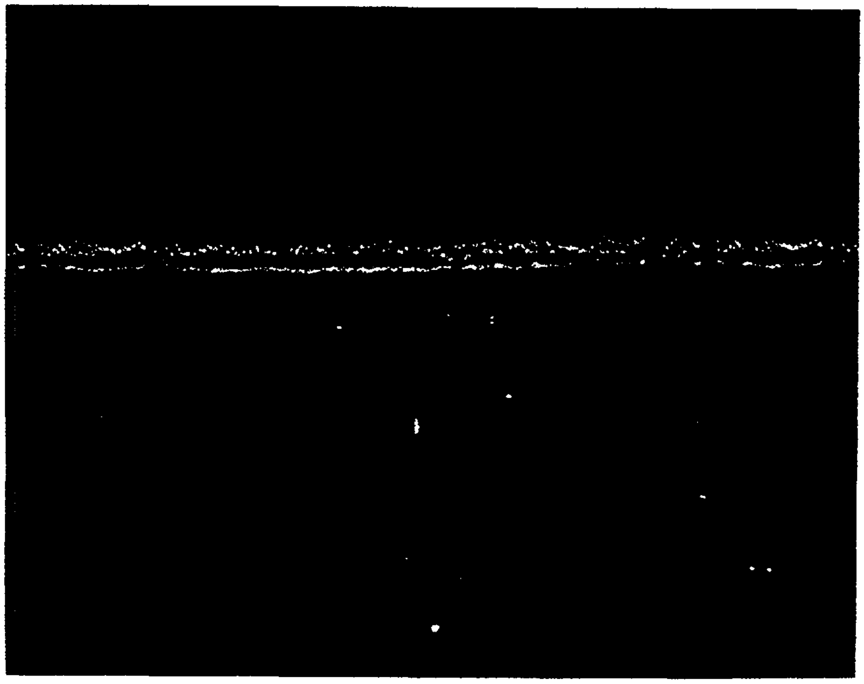


Plate 3-28. FVP - post-disposal, 25 May 1983.
Cancer irroratus exhibiting a defense response of self-burial into the sediment surface.

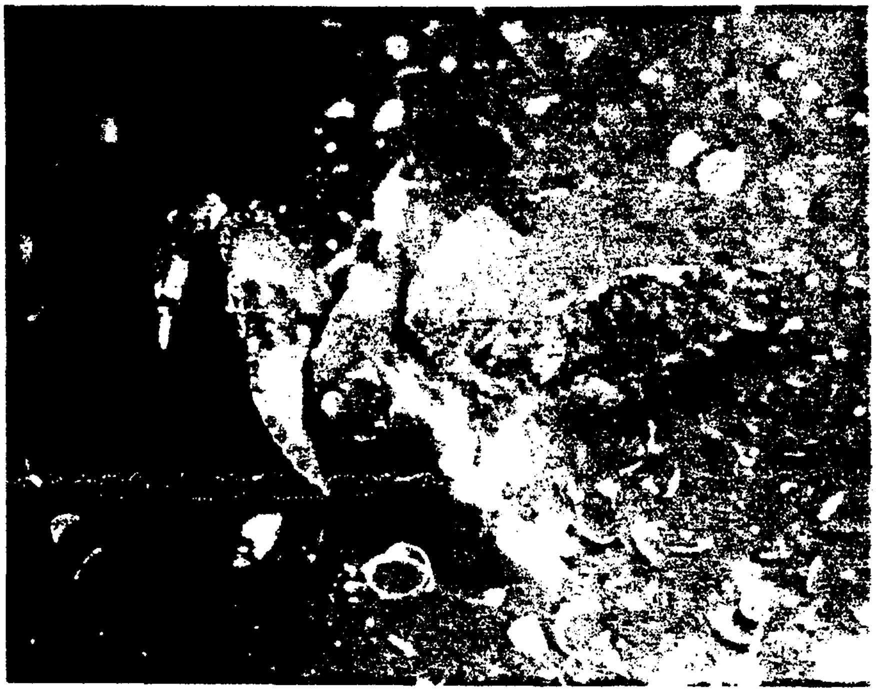


Plate 3-29. FVP - post-disposal, 25 May 1983
A Cancer irroratus using large oyster shell fragments that were transported with the dredged material, as shelter.

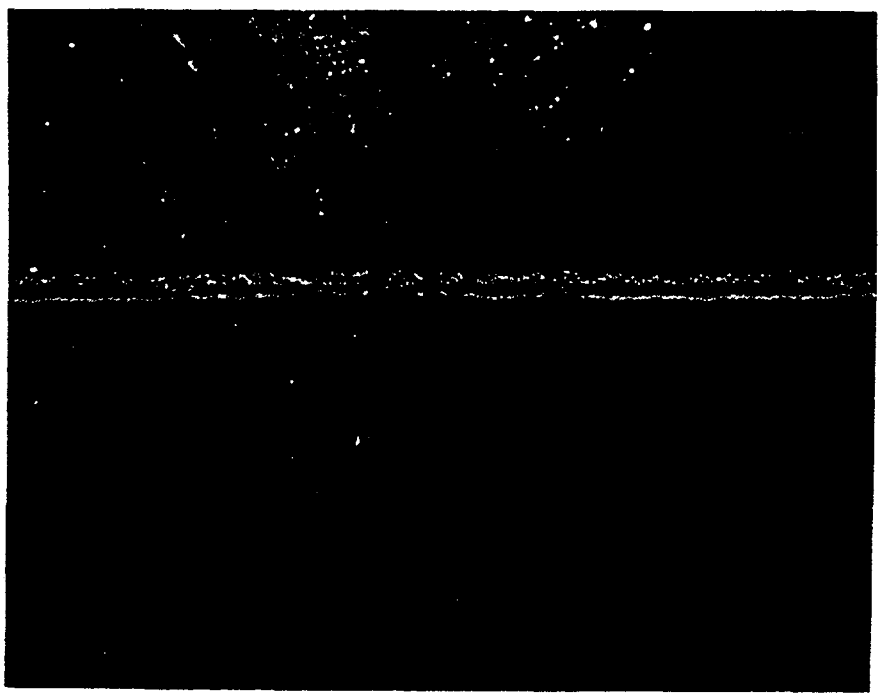


Plate 3-30. FVP - post-disposal, 15 June 1983
The winter flounder, Pseudopleuronectes americanus on soft uniformly smooth dredged material. Note fin track in soft cohesive sediment along edge of dorsal fin.

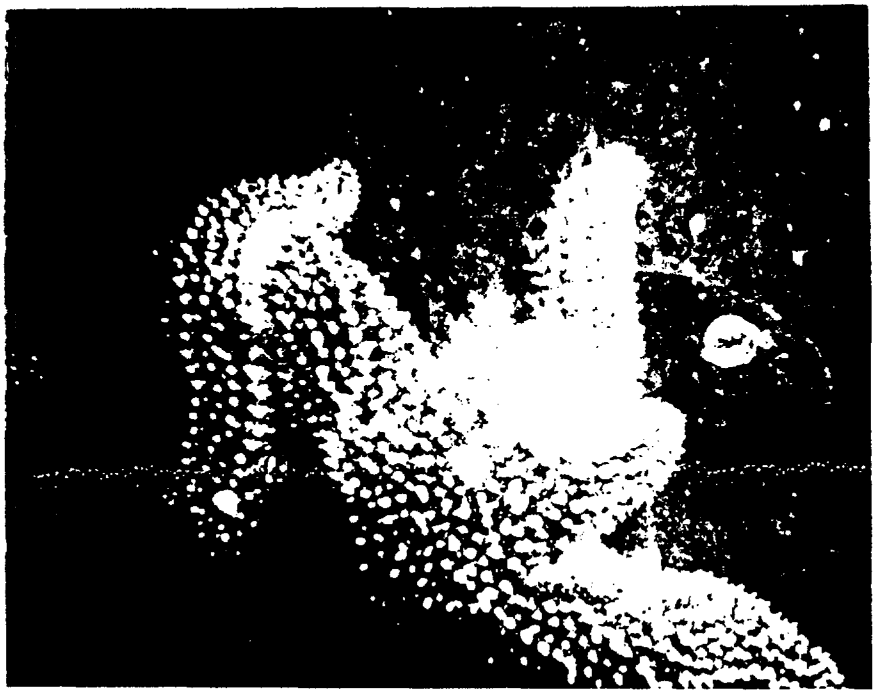


Plate 3-31. FVP - post-disposal, 15 June 1983
Two Asterias forbesi feeding on ribbed mussels Modiolus demissus.

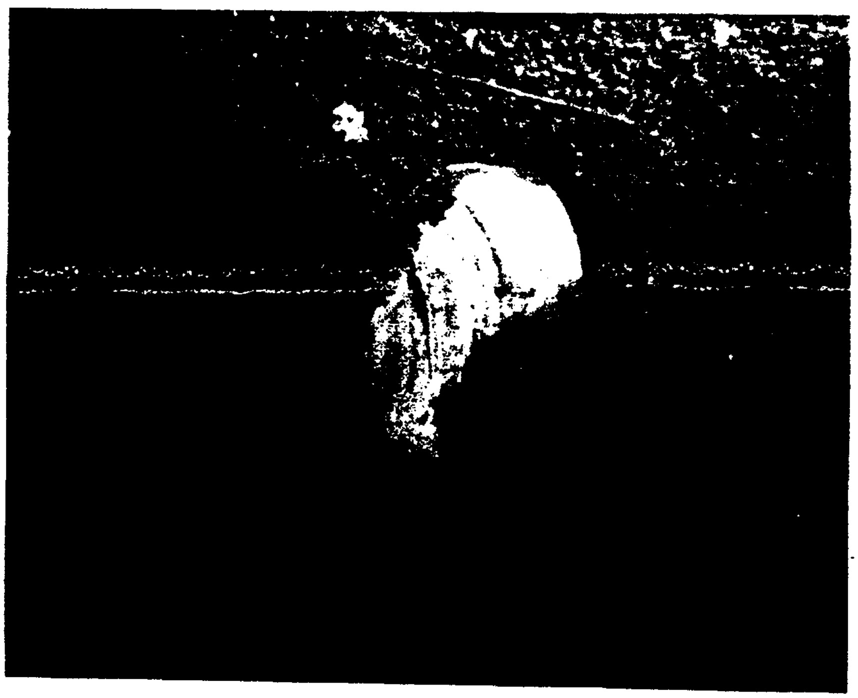


Plate 3-32. FVP - post-disposal, 15 June 1983
The soft shell clam, Mya arenaria, which is common in shallow areas in Long Island Sound, was probably transported to the disposal site with the dredge material.

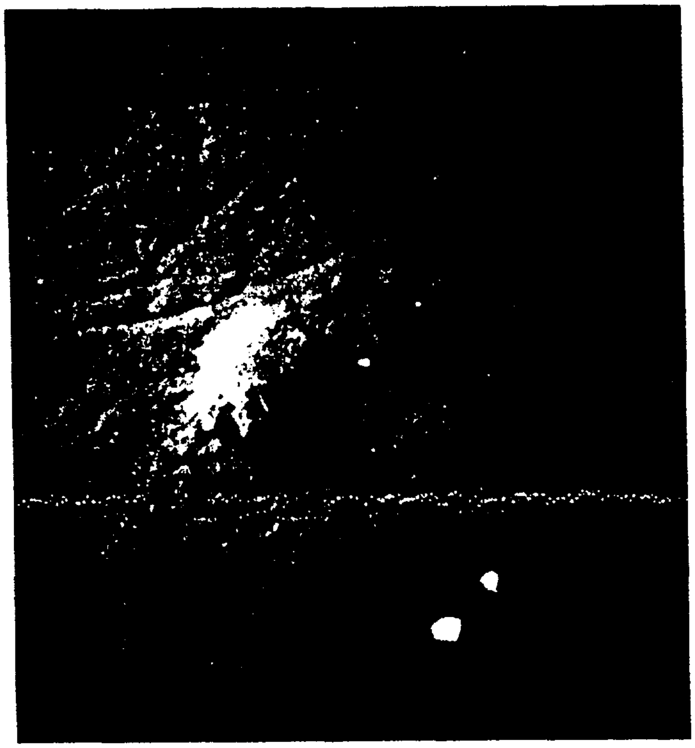


Plate 3-33. CLIS - FVP, S Border, Post-Disposal, 30 August 1983
A Pagurus pollicaris hermit crab with a heavily epiphitized shell tracking across soft dredge sediment.

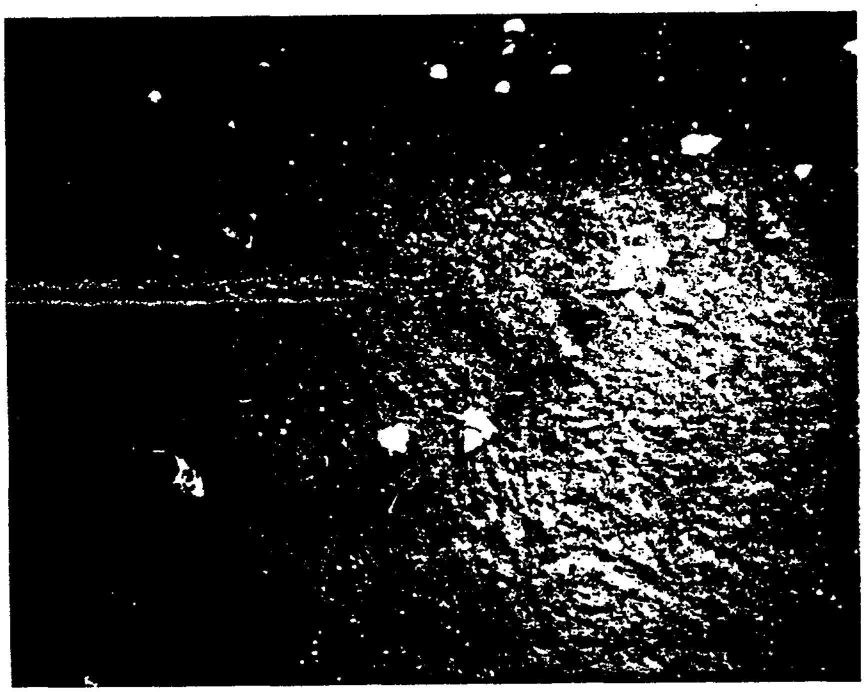


Plate 3-34. CLIS - FVP, S Border, Post-Disposal, 30 August 1983
Pagurus longicarpus, hermit crabs tracking the oxidized surface of flocculent natural sediment.

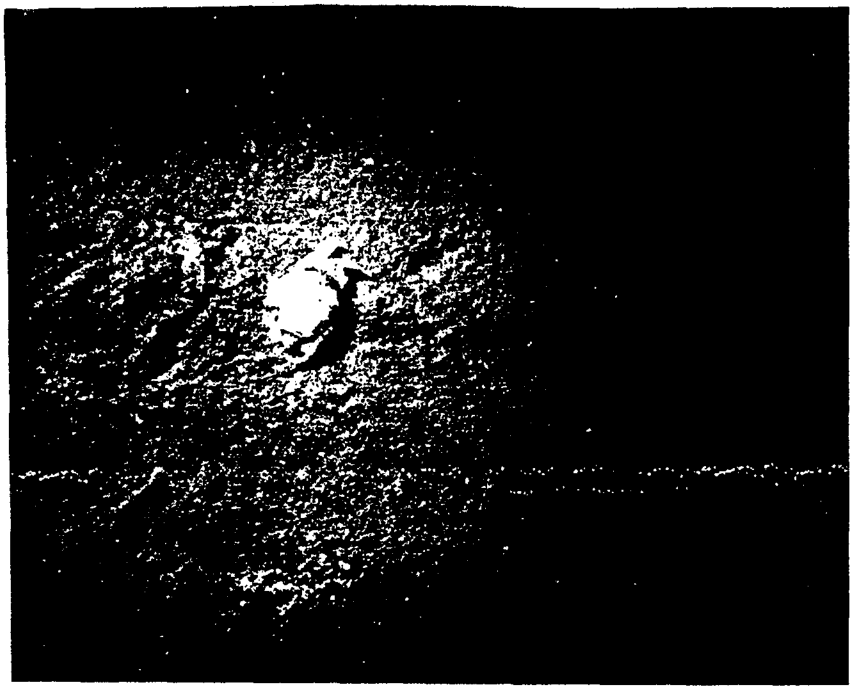


Plate 3-35. CLIS - FVP, S Border, Post-Disposal, 30 August 1983
A 2 cm juvenile Cancer irroratus tracking soft sediment.

Plate 3-36. CLIS - FVP, S Border, Post-Disposal, 30 August 1983
A 5 cm Cancer irroratus in a feeding excavation on dredge material.

Plate 3-37. CLIS - FVP, S Border, Post-Disposal, 30 August 1983
Tautagolabrus adspersus hovering over the sediment surface.

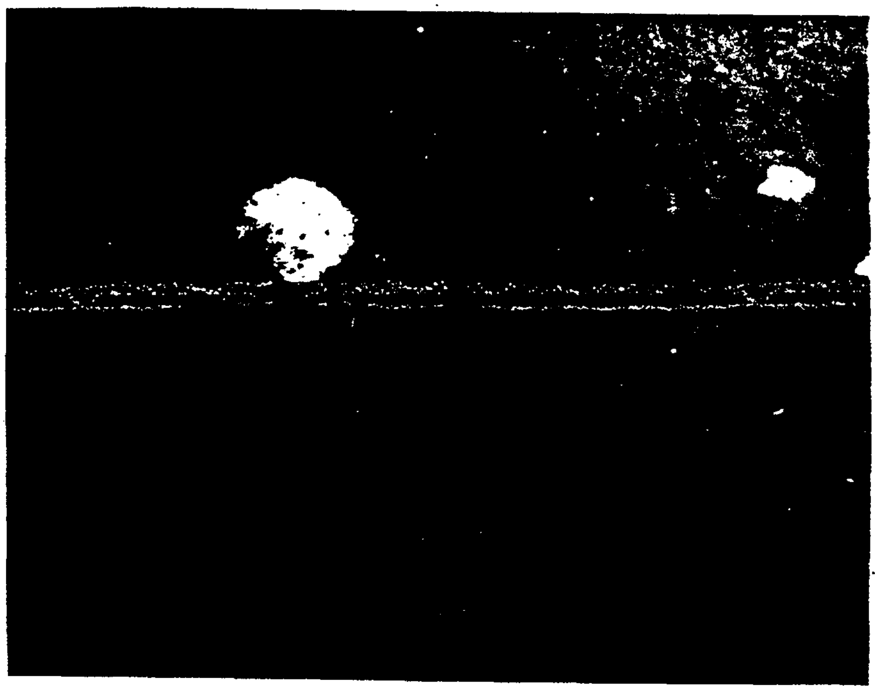


Plate 3-38. FVP, 400 m East of Center, 31 August 1983
The lady crab, Ovalipes sp., in a mass of gelatenous tuniacates.

Plate 3-39. FVP, 400 m East of Center, 31 August 1983
Foraging shrimp, Polaemonetes sp., showing flocculent sedimentation. Note Nassarius trivittatus in foreground and Pagurus longicarpus in left corner.

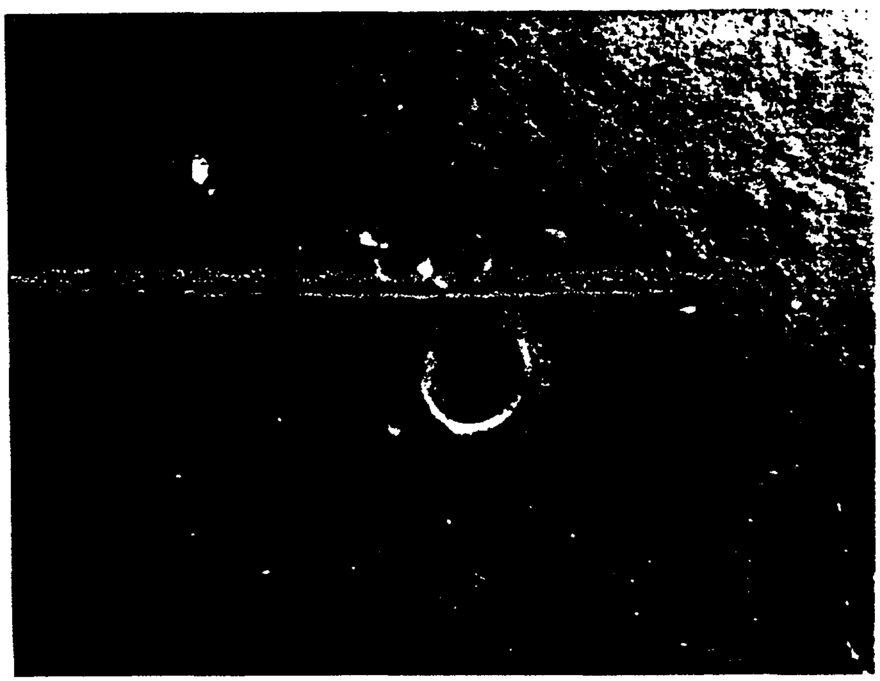


Plate 3-40. FVP, 400m East of Center, 31 August 1983
A 2 cm tube of the burrowing anemone Cerianthiopsis americana. The anemone is retracted. Note the track of a snail, probably Nassarius trivittatus, in the foreground.

Plate 3-41. FVP, Center, 31 August 1983
Cancer irroratus exhibiting escape behavior by rapid burrowing into the very soft oxidized surface of the dredge material.

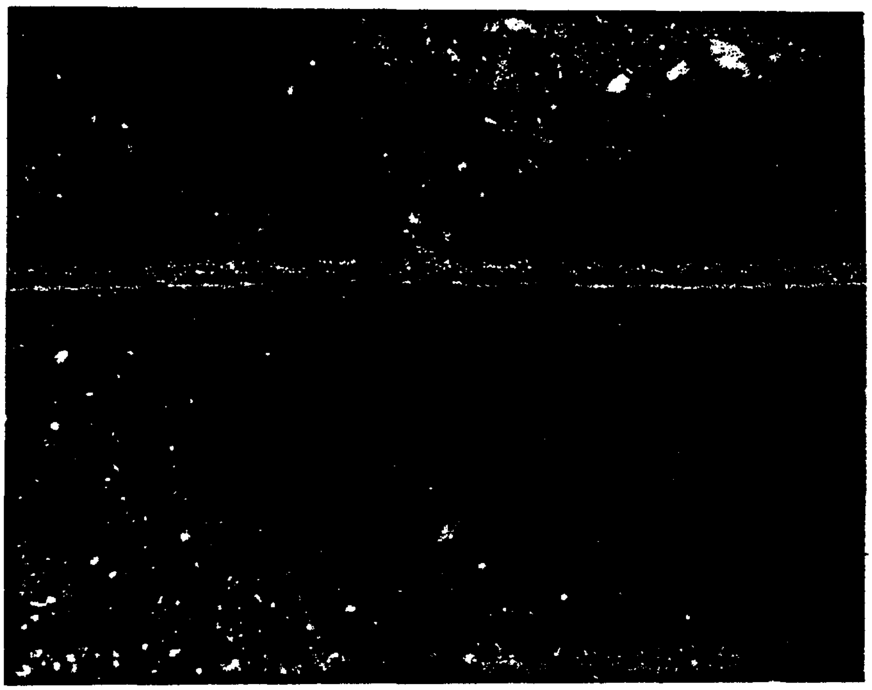


Plate 3-42. FVP, Center, 31 August 1983
Two hermit crabs, Pagurus longicarpus, foraging over gravel type dredge material near a Mytilus edulis valve.

Local Climatological Data

Annual Summary With Comparative Data

1982

BRIDGEPORT, CONNECTICUT

Narrative Climatological Summary

The airport is located on Stratford Point, a flat peninsula jutting out into Long Island Sound and the instruments are about one mile from the Sound which covers an arc extending from due north through east to west. Land around the airport is flat and marshy to the south and the land channel that connects it with the mainland west-northwest through northwest is flat and well populated. The cities of Stratford, Bridgeport, Milford, Fairfield and Westport are in close proximity to the station, whereas Norwalk, Danbury and Stamford are within a thirty-mile radius. The major smoke source to the station is Bridgeport itself, approximately 4 miles to the west; however, a southwest wind will cause a considerable decrease in visibility from the large cities that are located in that direction.

The terrain of the mainland is of glacial origin and rises in a rolling, mostly wooded, manner to the foothills of the Berkshires, 30 miles to the north and northwest, and the Catskills, about 60-70 miles to the northwest. There is some foehn effect with north and northwest winds and the upslope effect with the approach of a coastal low is quite pronounced. The most pronounced topographical effect, however, is that of the land-sea breeze which is most pronounced in the spring, summer and early autumn. The land-sea breeze effect during this period will inevitably cause a shift in the wind direction, even with a moderately strong isobaric flow.

Mean monthly temperatures during the summer months average 3 to 5 degrees lower than nearby inland stations as a result of the sea breeze. Likewise, temperatures during the fall and winter months are moderated several degrees due to the proximity of Long Island Sound.

Precipitation is slightly heavier than nearby inland stations the year around since coastal low pressure systems move quite consistently on a track to the south of Bridgeport. Winter snowfall is about 10" greater 10 or more miles inland. The greatest differences in shoreline and inland amounts occur in late autumn and late winter into early spring. One of the greater hazards along the coastal areas of Fairfield County is the accumulation of water (especially during periods of high tide) with the approach of a slowly-moving, deepening, low pressure system from the south. Severe storms occasionally cause inundation of 4 to 5 feet on the airport.

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AUG 1982 94702
BRIDGEPORT, CONNECTICUT
SIKORSKY MEMORIAL AIRPORT

ISSN 0198-1153

LOCAL CLIMATOLOGICAL DATA
Monthly Summary

NATIONAL WEATHER SERVICE OFC

LATITUDE 41° 10' N LONGITUDE 73° 08' W ELEVATION (GROUND) 7 FEET TIME ZONE EASTERN WBAN #94702

AUG 1982 BRIDGEPORT, CONNECTICUT

DATE 1	TEMPERATURE °F MAXIMUM 2	MINIMUM 3	AVERAGE 4	DEPARTURE FROM NORMAL 5	AVERAGE DEW POINT 6	DEGREE DAYS BASE 65°F HEATING (SEASON BEGINS WITH JUL) 7A	COOLING (SEASON BEGINS WITH JAN) 7B	WEATHER TYPES 1 FOG 2 HEAVY FOG 3 THUNDERSTORM 4 ICE PELLETS 5 HAIL 6 GLAZE 7 DUSTSTORM 8 SMOKE, HAZE 9 BLOWING SNOW 8	SNOW ICE PELLETS OR ICE ON GROUND AT 07AM INCHES 9	PRECIPITATION WATER EQUIVALENT (INCHES) 10	SNOW, ICE PELLETS (INCHES) 11	AVERAGE STATION PRESSURE IN INCHES ELEV. 17 FEET ABOVE M.S.L. 12	WIND (M.P.H.) RESULTANT DIR. 13	RESULTANT SPEED 14	AVERAGE SPEED 15	FASTEST MILE SPEED 16	FASTEST MILE DIRECTION 17	SUNSHINE MINUTES 18	PERCENT OF TOTAL POSSIBLE 19	SKY COVER (TENTHS) SUNRISE TO SUNSET 20	MIDNIGHT TO MIDNIGHT 21
1	82	63	73	-1		0	8	PHYSICAL OPERATION LESS THAN 24 HOURS DAILY	0	0	0					14	33			3	
2	82	62	72	-2		0	7		0	0	0					10	22			2	
3	78	66	72	-2		0	7		0	0	0					12	12			4	
4	78	66	72	-2		0	7		0	0	0					12	13			6	
5	86	69	78*	4		0	13		0	27	0					15	23			9	
6	75	65	70	-4		0	5		0	0	0					15	06			9	
7	79	62	71	-3		0	6		0	0	0					14	20			2	
8	80	67	74	0		0	9		0	0	0					16	22			7	
9	82	69	76	2		0	11		0	.80	0					15	18			8	
10	85	68	77	3		0	12		0	T	0					15	22			6	
11	71	60	66	-6		0	1		0	.10	0					9	27			10	
12	75	59	67	-6		0	2		0	.12	0					10	18			6	
13	78	56	67	-6		0	2		0	0	0					17	22			2	
14	78	54	66	-7		0	1		0	0	0					16	22			3	
15	83	57	70	-3		0	5		0	0	0					15	33			1	
16	87*	63	75	2		0	10		0	0	0					14	27			3	
17	82	65	74	1		0	9		0	18	0					15	18			6	
18	78	63	71	-2		0	6		0	0	0					13	21			3	
19	82	58	70	-2		0	5		0	0	0					16	22			3	
20	81	67	74	2		0	9		0	T	0					18	24			8	
21	72	54	63	-9		2	0		0	T	0					18	33			6	
22	69	46	58	-14		7	0		0	0	0					15	20			7	
23	74	62	68	-4		0	3		0	.40	0					18	22			10	
24	81	63	72	0		0	7		0	0	0					15	22			3	
25	75	58	67	-5		0	2		0	1.27	0					24	29			7	
26	78	55	67	-4		0	2		0	0	0					16	22			2	
27	74	63	69	-2		0	4		0	0	0					15	20			10	
28	73	52	63	-8		2	0		0	0	0					18	31			3	
29	69	44*	57*	-14		8	0		0	0	0					20	22			2	
30	72	58	65	-6		0	0		0	0	0					21	23			4	
31	79	61	70	0		0	5		0	T	0					16	23			8	

	MAXIMUM	MINIMUM	AVERAGE	DEPARTURE	DEW POINT	HEATING	COOLING
SUM / TOTAL	2418	1875				19	158
AVG / DEP	78.0	60.5	69.3	-3.4		19	-83

NUMBER OF DAYS				SEASON TO DATE HEATING	SEASON TO DATE COOLING
MAXIMUM TEMP ≥ 90°	MAXIMUM TEMP ≤ 32°	MINIMUM TEMP ≤ 32°	MINIMUM TEMP ≤ 0°	TOTAL 20	TOTAL 466
0	0	0	0	DEP 20	DEP -176

NUMBER OF DAYS	
PRECIPITATION ≥ .01 INCH	7
SNOW, ICE PELLETS ≥ 1.0 INCH	0
THUNDERSTORMS	
HEAVY FOG	
CLEAR 13 PARTLY CLOUDY 10 CLOUDY 8	

PRECIPITATION	
WATER EQUIVALENT TOTAL	3.14
WATER EQUIVALENT DEP	-0.66
SNOW, ICE PELLETS TOTAL	0

GREATEST IN 24 HOURS AND DATES			
PRECIPITATION		SNOW, ICE PELLETS	
1.27	25	0	

WIND FOR THE MONTH:		
FASTEST MILE	24	29
DATE:	25	

SUNSHINE TOTAL	% POSSIBLE FOR MONTH	SKY COVER SUM (SUNRISE TO SUNSET)	SUM (MIDNIGHT TO MIDNIGHT)
		163	
		AVG. 5.3	AVG.

GREATEST DEPTH ON GROUND OF SNOW, ICE PELLETS OR ICE AND DATE: 0

* EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.
T TRACE AMOUNT
+ ALSO ON EARLIER DATE(S).
HEAVY FOG: VISIBILITY 1/4 MILE OR LESS.
BLANK ENTRIES DENOTE MISSING DATA.

MINIMUM TEMP. IS NEW RECORD FOR AUGUST.

DATA IN COLS 6 AND 12-15 ARE BASED ON 7 OR MORE OBSERVATIONS AT 3-HOUR INTERVALS. RESULTANT WIND IS THE VECTOR SUM OF WIND SPEEDS AND DIRECTIONS DIVIDED BY THE NUMBER OF OBSERVATIONS. ONE OF THREE WIND SPEEDS IS GIVEN UNDER FASTEST MILE: FASTEST MILE - HIGHEST RECORDED SPEED FOR WHICH A MILE OF WIND PASSES STATION (DIRECTION IN COMPASS POINTS). FASTEST OBSERVED ONE MINUTE WIND - HIGHEST ONE MINUTE SPEED (DIRECTION IN TENS OF DEGREES). PEAK GUST - HIGHEST INSTANTANEOUS WIND SPEED (A APPEARS IN THE DIRECTION COLUMN). ERRORS WILL BE CORRECTED AND CHANGES IN SUMMARY DATA WILL BE ANNOTATED IN THE ANNUAL PUBLICATION.

I CERTIFY THAT THIS IS AN OFFICIAL PUBLICATION OF THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, AND IS COMPILED FROM RECORDS ON FILE AT THE NATIONAL CLIMATIC CENTER, ASHEVILLE, NORTH CAROLINA, 28801.

L. Ray Hoxit
ACTING DIRECTOR
NATIONAL CLIMATIC CENTER

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SEP 1982 94702
BRIDGEPORT, CONNECTICUT
SIKORSKY MEMORIAL AIRPORT

ISSN 0198-1153

LOCAL CLIMATOLOGICAL DATA
Monthly Summary

NATIONAL WEATHER SERVICE OFC

LATITUDE 41° 10' N LONGITUDE 73° 08' W ELEVATION (GROUND) 7 FEET TIME ZONE EASTERN WBAN #94702

SEP 1982
BRIDGEPORT, CONNECTICUT

DATE	TEMPERATURE °F: MAXIMUM	MINIMUM	AVERAGE	DEPARTURE FROM NORMAL	AVERAGE DEW POINT	DEGREE DAYS BASE 65°F: HEATING (SEASON BEGINS WITH JUL)	COOLING (SEASON BEGINS WITH JAN)	WEATHER TYPES: 1 FOG 2 HEAVY FOG 3 THUNDERSTORM 4 ICE PELLETS 5 HAIL 6 GLAZE 7 DUSTSTORM 8 SMOKE, HAZE 9 BLOWING SNOW	SNOW ICE PELLETS OR ICE ON GROUND AT 07AM INCHES	PRECIPITATION: WATER EQUIVALENT (INCHES)	SNOW, ICE PELLETS (INCHES)	AVERAGE STATION PRESSURE IN INCHES ELEV 17 FEET ABOVE M.S.L.	WIND (M.P.H.): RESULTANT DIR.	RESULTANT SPEED	AVERAGE SPEED	FASTEST MILE: SPEED	DIRECTION	SUNSHINE: MINUTES	PERCENT OF TOTAL POSSIBLE	SKY COVER (TENTHS): SUNRISE TO SUNSET	MIDNIGHT TO MIDNIGHT	DATE
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
1	74	65	70	0		0	5	PHYSICAL OPERATION LESS THAN 24 HOURS DAILY	0	.45	0					15	22			10		
2	79	65	72	2		0	7		0	.02	0					15	18			7		
3	82	62	72*	2		0	7		0	.07	0					16	28			5		
4	74	53	64	-6		1	0		0	0	0					15	31			4		
5	74	49	62	-7		3	0		0	0	0					12	02			2		
6	77	53	65	-4		0	0		0	0	0					12	18			5		
7	71	56	64	-5		1	0		0	T	0					17	08			7		
8	68	55	62	-7		3	0		0	0	0					10	07			10		
9	76	54	65	-3		0	0		0	0	0					17	27			3		
10	81	58	70	2		0	5		0	0	0					14	22			0		
11	82*	56	69	1		0	4		0	0	0					10	22			3		
12	79	60	70	2		0	5		0	0	0					12	05			3		
13	73	63	68	1		0	3		0	0	0					13	08			7		
14	73	63	68	1		0	3		0	0	0					10	15			3		
15	76	61	69	2		0	4		0	0	0					10	17			8		
16	71	60	66	-1		0	1		0	T	0					15	36			10		
17	70	50	60	-6		5	0		0	0	0					21	34			2		
18	74	48*	61	-5		4	0		0	0	0					18	24			7		
19	66	49	58	-8		7	0		0	0	0					16	36			0		
20	62	50	56*	-9		9	0		0	.47	0					18	04			10		
21	64	52	58	-7		7	0		0	0	0					23	07			10		
22	66	55	61	-4		4	0		0	.11	0					18	04			10		
23	68	57	63	-1		2	0		0	T	0					28	25			4		
24	70	50	60	-4		5	0		0	0	0					13	22			5		
25	70	51	61	-3		4	0		0	0	0					12	06			7		
26	70	52	61	-2		4	0		0	T	0					20	06			7		
27	73	59	66	3		0	1		0	.18	0					29	09			10		
28	72	55	64	1		1	0		0	0	0					10	14			9		
29	70	57	64	1		1	0		0	0	0					18	05			7		
30	64	55	60	-2		5	0		0	T	0					14	04			10		

	MAXIMUM	MINIMUM	AVERAGE	DEPARTURE	DEW POINT	HEATING	COOLING		PRECIP. WATER EQUIV.	SNOW, ICE PELLETS	FOR THE MONTH: FASTEST MILE SPEED	DIRECTION	SUNSHINE	%	SKY COVER SUNRISE TO SUNSET	MIDNIGHT TO MIDNIGHT
	SUM	SUM				TOTAL	TOTAL	NUMBER OF DAYS	TOTAL	TOTAL			TOTAL	% FOR MONTH	SUM	SUM
	2169	1673				66	45		1.30	0	29	09			185	
	AVG.	AVG	AVG	DEP.	AVG.	DEP	DEP.	PRECIPITATION	DEP.		DATE: 27		POSSIBLE		AVG.	AVG
	72.3	55.8	64.1	-2.4		24	-42	> .01 INCH 6	-1.58						6.2	

NUMBER OF DAYS				SEASON TO DATE			GREATEST IN 24 HOURS AND DATES				GREATEST DEPTH ON GROUND OF SNOW, ICE PELLETS OR ICE AND DATE
MAXIMUM TEMP.		MINIMUM TEMP.		TOTAL	TOTAL	SNOW, ICE PELLETS > 1.0 INCH 0	PRECIPITATION		SNOW, ICE PELLETS		
> 90°	< 32°	< 32°	< 0°	86	511	THUNDERSTORMS	.47	20	0		0
0	0	0	0	DEP	DEP	HEAVY FOG					
				44	-218	CLEAR 8 PARTLY CLOUDY 12 CLOUDY 10					

* EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.
T TRACE AMOUNT.
+ ALSO ON EARLIER DATE(S).
HEAVY FOG: VISIBILITY 1/4 MILE OR LESS.
BLANK ENTRIES DENOTE MISSING DATA.

DATA IN COLS 6 AND 12-15 ARE BASED ON 7 OR MORE OBSERVATIONS AT 3-HOUR INTERVALS. RESULTANT WIND IS THE VECTOR SUM OF WIND SPEEDS AND DIRECTIONS DIVIDED BY THE NUMBER OF OBSERVATIONS. *ONE OF THREE WIND SPEEDS IS GIVEN UNDER FASTEST MILE:* FASTEST MILE - HIGHEST RECORDED SPEED FOR WHICH A MILE OF WIND PASSES STATION (DIRECTION IN COMPASS POINTS). FASTEST OBSERVED ONE MINUTE WIND - HIGHEST ONE MINUTE SPEED (DIRECTION IN TENS OF DEGREES). PEAK GUST - HIGHEST INSTANTANEOUS WIND SPEED (A APPEARS IN THE DIRECTION COLUMN). ERRORS WILL BE CORRECTED AND CHANGES IN SUMMARY DATA WILL BE ANNOTATED IN THE ANNUAL PUBLICATION.

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ACTING DIRECTOR
NATIONAL CLIMATIC CENTER

noaa NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION / ENVIRONMENTAL DATA AND INFORMATION SERVICE / NATIONAL CLIMATIC CENTER ASHEVILLE, NORTH CAROLINA

OCT 1982 BRIDGEP CONNECTICUT

OCT 1982 94702
BRIDGEPORT, CONNECTICUT
SIKORSKY MEMORIAL AIRPORT

ISSN 0198-1153

LOCAL CLIMATOLOGICAL DATA
Monthly Summary

NATIONAL WEATHER SERVICE OFC

LATITUDE 41° 10' N LONGITUDE 73° 08' W ELEVATION (GROUND) 7 FEET TIME ZONE EASTERN WBAN #94702

Date	Temperature °F: Maximum	Minimum	Average	Departure from normal	Average dew point	Degree days base 65°F: Heating (season begins with Jul)	Cooling (season begins with Jan)	Weather types (1 Fog, 2 Heavy fog, 3 Thunderstorm, 4 Ice pellets, 5 Hail, 6 Glaze, 7 Duststorm, 8 Smoke, haze, 9 Blowing snow)	Snow, ice pellets or ice on ground at 07AM (inches)	Precipitation: Water equivalent (inches)	Snow, ice pellets (inches)	Average station pressure in inches, elev. 17 feet above M.S.L.	Wind (M.P.H.): Resultant dir.	Resultant speed	Average speed	Fastest mile: Speed	Direction	Sunshine: Minutes	Percent of total possible	Sky cover (tenths): Sunrise to sunset	Midnight to midnight	Date
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	74	54	64	2		1	0	PHYSICAL OPERATION LESS THAN 24 HOURS DAILY	0	0	0					15	23			0		1
2	68	51	60	-2		5	0		0	0	0					20	35			0		2
3	65	44	55	-6		10	0		0	0	0					16	23			3		3
4	75	57	66	5		0	1		0	0	0					15	33			10		4
5	69	53	61	0		4	0		0	0	0					13	02			6		5
6	75*	54	65	5		0	0		0	0	0					15	21			2		6
7	67	56	62	2		3	0		0	.17	0					20	09			9		7
8	73	59	66*	7		0	1		0	0	0					15	20			9		8
9	59	48	54	-5		11	0		0	.51	0					22	04			9		9
10	55	37	46	-13		19	0		0	0	0					22	05			1		10
11	58	35	47	-11		18	0		0	0	0					12	12			1		11
12	60	46	53	-5		12	0		0	0	0					10	06			10		12
13	60	52	56	-2		9	0		0	.16	0					12	18			10		13
14	66	54	60	3		5	0		0	T	0					16	34			3		14
15	64	50	57	0		8	0		0	0	0					23	26			5		15
16	60	42	51	-6		14	0		0	.01	0					21	27			5		16
17	53	35	44	-12		21	0		0	0	0					18	33			2		17
18	57	32	45	-11		20	0		0	0	0					16	23			3		18
19	62	37	50	-6		15	0		0	0	0					15	21			3		19
20	68	42	55	0		10	0		0	0	0					15	20			3		20
21	63	42	53	-2		12	0		0	.10	0					17	34			4		21
22	51	33	42	-13		23	0		0	0	0					17	33			0		22
23	50	29*	40*	-15		25	0		0	0	0					15	35			6		23
24	53	30	42	-12		23	0		0	0	0					20	04			9		24
25	46	38	42	-12		23	0		0	.55	0					24	02			10		25
26	60	41	51	-3		14	0		0	.02	0					23	02			10		26
27	57	36	47	-6		18	0		0	0	0					10	11			0		27
28	61	33	47	-6		18	0		0	0	0					14	23			3		28
29	67	35	51	-2		14	0		0	0	0					16	20			1		29
30	67	44	56	4		9	0		0	0	0					14	24			7		30
31	66	50	58	6		7	0		0	T	0					12	22			10		31
	SUM	SUM				TOTAL	TOTAL	NUMBER OF DAYS		TOTAL	TOTAL	FOR THE MONTH:						TOTAL	% FOR MONTH	SUM	SUM	
	1929	1349				371	2			1.52	0					24	02			154		
	AVG	AVG	AVG	DEP	AVG	DEP	DEP.	PRECIPITATION		DEP.						DATE:	25	POSSIBLE		AVG	AVG	
	62.2	43.5	52.9	-3.9		110	-4	> .01 INCH	7	-1.27										5.0		

NUMBER OF DAYS				SEASON TO DATE				GREATEST IN 24 HOURS AND DATES			GREATEST DEPTH ON GROUND OF SNOW, ICE PELLETS OR ICE AND DATE
MAXIMUM TEMP		MINIMUM TEMP		TOTAL	TOTAL	SNOW, ICE PELLETS > 1.0 INCH	0	PRECIPITATION		SNOW, ICE PELLETS	
≥ 90°	≤ 32°	≤ 32°	≤ 0°	457	513	THUNDERSTORMS		57	25-26	0	0
0	0	3	0	DEP	DEP	HEAVY FOG					
				154	-222	CLEAR 15 PARTLY CLOUDY 6 CLOUDY 10					

* EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.
T TRACE AMOUNT.
\+ ALSO ON EARLIER DATE(S).
HEAVY FOG: VISIBILITY 1/4 MILE OR LESS.
BLANK ENTRIES DENOTE MISSING DATA.

DATA IN COLS 6 AND 12-15 ARE BASED ON 7 OR MORE OBSERVATIONS AT 3-HOUR INTERVALS. RESULTANT WIND IS THE VECTOR SUM OF WIND SPEEDS AND DIRECTIONS DIVIDED BY THE NUMBER OF OBSERVATIONS. ONE OF THREE WIND SPEEDS IS GIVEN UNDER FASTEST MILE: FASTEST MILE - HIGHEST RECORDED SPEED FOR WHICH A MILE OF WIND PASSES STATION (DIRECTION IN COMPASS POINTS). FASTEST OBSERVED ONE MINUTE WIND - HIGHEST ONE MINUTE SPEED (DIRECTION IN TENS OF DEGREES). PEAK GUST - HIGHEST INSTANTANEOUS WIND SPEED (A / APPEARS IN THE DIRECTION COLUMN). ERRORS WILL BE CORRECTED AND CHANGES IN SUMMARY DATA WILL BE ANNOTATED IN THE ANNUAL PUBLICATION.

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L. Ray Hoxit
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NOV 1982 BRIDGEPORT, CONNECTICUT

NOV 1982 94702
BRIDGEPORT, CONNECTICUT
SIKORSKY MEMORIAL AIRPORT

ISSN 0198-1153

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Monthly Summary

NATIONAL WEATHER SERVICE OFC

LATITUDE 41° 10' N LONGITUDE 73° 08' W ELEVATION (GROUND) 7 FEET TIME ZONE EASTERN WBAN #94702

DATE 1	TEMPERATURE °F: MAXIMUM 2	MINIMUM 3	AVERAGE 4	DEPARTURE FROM NORMAL 5	AVERAGE DEW POINT 6	DEGREE DAYS BASE 65°F: HEATING (SEASON BEGINS WITH JUL) 7A	COOLING (SEASON BEGINS WITH JAN) 7B	WEATHER TYPES (1 FOG, 2 HEAVY FOG, 3 THUNDERSTORM, 4 ICE PELLETS, 5 HAIL, 6 GLAZE, 7 DUSTSTORM, 8 SMOKE, HAZE, 9 BLOWING SNOW) 8	SNOW ICE PELLETS OR ICE ON GROUND AT 07AM INCHES 9	PRECIPITATION: WATER EQUIVALENT (INCHES) 10	SNOW, ICE PELLETS (INCHES) 11	AVERAGE STATION PRESSURE IN INCHES ELEV. 17 FEET ABOVE M.S.L. 12	WIND (M.P.H.): RESULTANT DIR. 13	RESULTANT SPEED 14	AVERAGE SPEED 15	FASTEST MILE: SPEED 16	DIRECTION 17	SUNSHINE: MINUTES 18	PERCENT OF TOTAL POSSIBLE 19	SKY COVER (TENTHS): SUNRISE TO SUNSET 20	MIDNIGHT TO MIDNIGHT 21	DATE 22
1	69	53	61	9		4	0	PHYSICAL OPERATION LESS THAN 24 HOURS DAILY	0	0	0					15	24			6		1
2	71*	52	62	11		3	0		0	0	0					13	19			2		2
3	65	56	61	10		4	0		0	T	0					12	08			10		3
4	69	58	64*	13		1	0		0	.04	0					25	19			10		4
5	66	36	51	1		14	0		0	.43	0					20	20			9		5
6	50	32	41	-9		24	0		0	0	0					18	27			1		6
7	53	32	43	-7		22	0		0	0	0					17	26			0		7
8	63	42	53	4		12	0		0	0	0					22	24			1		8
9	56	38	47	-2		18	0		0	0	0					15	33			7		9
10	51	29	40	-8		25	0		0	0	0					13	01			2		10
11	58	33	46	-2		19	0		0	T	0					21	20			8		11
12	63	54	59	11		6	0		0	.04	0					30	19			10		12
13	58	37	48	1		17	0		0	1.27	0					21	32			10		13
14	47	31	39	-8		26	0		0	0	0					16	14			7		14
15	47	30	39	-7		26	0		0	.11	0					24	30			6		15
16	44	26	35	-11		30	0		0	0	0					21	22			4		16
17	50	34	42	-4		23	0		0	0	0					12	24			9		17
18	53	33	43	-2		22	0		0	0	0					13	03			9		18
19	53	40	47	2		18	0		0	0	0					18	06			8		19
20	53	42	48	4		17	0		0	0	0					14	08			10		20
21	57	48	53	9		12	0		0	0	0					9	06			10		21
22	60	53	57	14		8	0		0	0	0					9	06			9		22
23	60	47	54	11		11	0		0	0	0					10	14			7		23
24	56	35	46	4		19	0		0	.01	0					25	31			9		24
25	46	29	38	-4		27	0		0	0	0					17	24			0		25
26	50	38	44	2		21	0		0	.02	0					21	24			10		26
27	45	24	35	-6		30	0		0	0	0					21	33			2		27
28	39	20*	30*	-11		35	0		0	.32	0					8	02			10		28
29	52	39	46	6		19	0		0	.89	0					18	23			9		29
30	56	40	48	8		17	0		0	0	0					13	30			4		30
	SUM 1660	SUM 1161				TOTAL 530	TOTAL 0	NUMBER OF DAYS		TOTAL 3.13	TOTAL 0		FOR THE MONTH:			30	19	TOTAL	% FOR MONTH	SUM 199	SUM	
	AVG. 55.3	AVG. 38.7	AVG. 47.0	DEP. 1.0	AVG.	DEP. -40	DEP. 0	PRECIPITATION ≥ .01 INCH 9		DEP. -0.70						DATE: 12		POSSIBLE		AVG. 6.6	AVG.	

NUMBER OF DAYS				SEASON TO DATE			GREATEST IN 24 HOURS AND DATES			GREATEST DEPTH ON GROUND OF SNOW, ICE PELLETS OR ICE AND DATE
MAXIMUM TEMP		MINIMUM TEMP		TOTAL	TOTAL	SNOW, ICE PELLETS ≥ 1.0 INCH 0	PRECIPITATION		SNOW, ICE PELLETS	
≥ 90°	≤ 32°	≤ 32°	≤ 0°	987	513	THUNDERSTORMS	1.31	12-13	0	0
0	0	9	0	DEP. 114	DEP. -222	HEAVY FOG				
						CLEAR 7 PARTLY CLOUDY 7 CLOUDY 16				

* EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.
T TRACE AMOUNT.
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1	55	38	47	8		18	0	PHYSICAL OPERATION LESS THAN 24 HOURS DAILY	0	.05	0					13	21			10	
2	56	46	51	12		14	0		0	0	0					14	23			8	
3	54	48	51	13		14	0		0	T	0					15	23			10	
4	61	48	55	17		10	0		0	T	0					16	22			7	
5	57	50	54	17		11	0		0	T	0					20	07			10	
6	61	53	57*	20		8	0		0	.09	0					24	22			10	
7	53	43	48	12		17	0		0	0	0					17	31			1	
8	45	34	40	4		25	0		0	0	0					17	22			0	
9	47	16	32	-4		33	0		0	0	0					26	34			3	
10	33	12	23	-12		42	0		0	T	T					14	30			10	
11	35	28	32	-3		33	0		T	.07	.7					20	36			10	
12	28	16	22	-12		43	0		1	.10	1.0					22	01			10	
13	21	10	16*	-18		49	0		2	0	0					16	36			0	
14	38	10*	24	-10		41	0		2	0	0					24	24			8	
15	48	26	37	4		28	0		1	0	0					15	27			5	
16	57	44	51	18		14	0		0	.41	0					26	18			10	
17	44	25	35	2		30	0		0	0	0					20	35			5	
18	29	22	26	-7		39	0		0	T	T					21	03			6	
19	33	28	31	-1		34	0		T	0	0					16	03			10	
20	37	30	34	2		31	0		1	.10	1.0					18	25			10	
21	41	33	37	5		28	0		T	0	0					18	27			9	
22	40	26	33	1		32	0		0	0	0					18	34			2	
23	39	25	32	0		33	0		T	.05	.5					20	06			10	
24	45	37	41	10		24	0		0	.11	0					9	03			10	
25	52	36	44	13		21	0		0	.02	0					13	20			10	
26	62*	40	51	20		14	0		0	T	0					23	31			10	
27	44	27	36	5		29	0		0	1	0					12	08			10	
28	52	43	48	17		17	0		0	0	0					18	21			10	
29	57	39	48	17		17	0		0	.05	0					16	24			10	
30	42	30	36	5		29	0		0	0	0					10	34			3	
31	38	30	34	3		31	0		0	.05	T					14	03			9	
	SUM 1404	SUM 993				TOTAL 809	TOTAL 0	NUMBER OF DAYS		TOTAL 1.10	TOTAL 3.2	FOR THE MONTH:				26	18	TOTAL	% FOR MONTH	SUM 236	SUM
	AVG. 45.3	AVG. 32.0	AVG. 38.7	DEP. 4.9	AVG.	DEP. -158	DEP. 0	PRECIPITATION > .01 INCH 11		DEP. -2.34						DATE: 16+		POSSIBLE		AVG. 7.6	AVG.

NUMBER OF DAYS				SEASON TO DATE			
MAXIMUM TEMP		MINIMUM TEMP		TOTAL	TOTAL	SNOW, ICE PELLETS > 1.0 INCH	2
≥ 90°	≤ 32°	≤ 32°	≤ 0°	1796	513	THUNDERSTORMS	
0	3	16	0	DEP. -44	DEP. -222	HEAVY FOG	
						CLEAR 6 PARTLY CLOUDY 4 CLOUDY 21	

GREATEST IN 24 HOURS AND DATES				GREATEST DEPTH ON GROUND OF SNOW, ICE PELLETS OR ICE AND DATE	
PRECIPITATION		SNOW, ICE PELLETS			
.41	16	1.6	11-12	2	14+

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APPENDIX III
TABLE 3-21f

JAN 1983 94702
BRIDGEPORT, CONNECTICUT
SIKORSKY MEMORIAL AIRPORT

ISSN 0198-1153

LOCAL CLIMATOLOGICAL DATA
Monthly Summary

NATIONAL WEATHER SERVICE OFC

LATITUDE 41° 10' N LONGITUDE 73° 08' W ELEVATION (GROUND) 7 FEET TIME ZONE EASTERN WBAN #94702

DATE	TEMPERATURE °F: MAXIMUM	MINIMUM	AVERAGE	DEPARTURE FROM NORMAL	AVERAGE DEW POINT	DEGREE DAYS BASE 65°F: HEATING (SEASON BEGINS WITH JUL)	COOLING (SEASON BEGINS WITH JAN)	WEATHER TYPES: 1 FOG 2 HEAVY FOG 3 THUNDERSTORM 4 ICE PELLETS 5 HAIL 6 GLAZE 7 DUSTSTORM 8 SMOKE, HAZE 9 BLOWING SNOW	SNOW ICE PELLETS OR ICE ON GROUND AT 07AM INCHES	PRECIPITATION: WATER EQUIVALENT (INCHES)	SNOW, ICE PELLETS (INCHES)	AVERAGE STATION PRESSURE IN INCHES ELEV. 17 FEET ABOVE M.S.L.	WIND (M.P.H.): RESULTANT DIR.	RESULTANT SPEED	AVERAGE SPEED	FASTEST MILE: SPEED	DIRECTION	SUNSHINE: MINUTES	PERCENT OF TOTAL POSSIBLE	SKY COVER (TENTHS): SUNRISE TO SUNSET	MIDNIGHT TO MIDNIGHT	DATE
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	43	30	37	6		28	0	PHYSICAL OPERATION LESS THAN 24 HOURS DAILY	0	0	0					18	23			0		1
2	43	31	37	6		28	0		0	0	0					16	24			10		2
3	39	28	34	3		31	0		0	0	0					17	32			0		3
4	35	20	28	-3		37	0		0	0	0					14	08			0		4
5	44	30	37	6		28	0		0	.15	0					13	06			9		5
6	42	29	36	5		29	0		0	.52	0					21	35			9		6
7	46	25	36	6		29	0		0	0	0					15	23			10		7
8	46	31	39	9		26	0		0	0	0					18	31			7		8
9	36	27	32	2		33	0		0	0	0					18	06			4		9
10	51	30	41	11		24	0		T	.76	T					24	08			10		10
11	55*	40	48*	18		17	0		0	.20	0					20	24			7		11
12	46	27	37	7		28	0		0	0	0					18	34			7		12
13	31	19	25	-5		40	0		0	0	0					22	33			0		13
14	33	16	25	-5		40	0		0	0	0					9	14			1		14
15	34	30	32	2		33	0		T	.51	5.1					29	02			10		15
16	33	23	28	-2		37	0		5	T	T					23	31			8		16
17	28	20	24	-6		41	0		3	0	0					20	27			3		17
18	21	4	13	-17		52	0		3	0	0					21	32			4		18
19	16	0*	8*	-22		57	0		3	0	0					25	33			1		19
20	22	5	14	-16		51	0		3	0	0					24	34			0		20
21	33	16	25	-5		40	0		2	0	0					12	35			4		21
22	34	18	26	-4		39	0		2	0	0					12	04			7		22
23	49	31	40	10		25	0		2	1.19	0					23	07			10		23
24	47	36	42	12		23	0		T	0	0					21	28			8		24
25	43	33	38	8		27	0		0	0	0					18	24			9		25
26	37	27	32	2		33	0		0	0	0					14	31			2		26
27	32	25	29	-1		36	0		0	0	0					13	04			10		27
28	35	25	30	0		35	0		0	0	0					23	03			9		28
29	37	27	32	2		33	0		0	0	0					10	04			5		29
30	40	27	34	4		31	0		0	.39	0					15	08			10		30
31	47	36	42	12		23	0		0	0	0					15	31			7		31
	SUM	SUM				TOTAL	TOTAL	NUMBER OF DAYS		TOTAL	TOTAL	FOR THE MONTH:						TOTAL	Σ FOR MONTH	SUM	SUM	
	1178	766				1034	0			3.72	5.1					29	02			181		
	AVG.	AVG.	AVG.	DEP.	AVG.	DEP.	DEP.	PRECIPITATION		DEP.						DATE: 15		POSSIBLE		AVG.	AVG.	
	36.0	24.7	31.4	1.9		-45	0	> .01 INCH	7	0.47										5.8		

NUMBER OF DAYS				SEASON TO DATE				GREATEST IN 24 HOURS AND DATES				GREATEST DEPTH ON GROUND OF SNOW, ICE PELLETS OR ICE AND DATE	
MAXIMUM TEMP.		MINIMUM TEMP.		TOTAL	TOTAL	SNOW, ICE PELLETS > 1.0 INCH	1	PRECIPITATION		SNOW, ICE PELLETS			
≥ 90°	≤ 32°	≤ 32°	≤ 0°	2830	0	THUNDERSTORMS		1.19	23	5.1	15	5	16+
0	6	27	1	DEP.	DEP.	HEAVY FOG							
				-89	0	CLEAR 9	PARTLY CLOUDY 9	CLOUDY 13					

* EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.
T TRACE AMOUNT.
+ ALSO ON EARLIER DATE(S).
HEAVY FOG: VISIBILITY 1/4 MILE OR LESS.
BLANK ENTRIES DENOTE MISSING OR UNREPORTED DATA.

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L. Ray Hoxit
ACTING DIRECTOR
NATIONAL CLIMATIC DATA CENTER

noaa NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION — NATIONAL ENVIRONMENTAL SATELLITE, DATA AND INFORMATION SERVICE — NATIONAL CLIMATIC DATA CENTER ASHEVILLE NORTH CAROLINA

JAN 1983
BRIDGEPORT, CONNECTICUT

FEB 1983 94702
BRIDGEPORT, CONNECTICUT
SIKORSKY MEMORIAL AIRPORT

ISSN 0198-1153

LOCAL CLIMATOLOGICAL DATA

Monthly Summary

NATIONAL WEATHER SERVICE OFC

LATITUDE 41° 10' N LONGITUDE 73° 08' W ELEVATION (GROUND) 7 FEET TIME ZONE EASTERN WBAN #94702

FEB 1983
BRIDGEPORT, CONNECTICUT

DATE	TEMPERATURE °F: MAXIMUM	MINIMUM	AVERAGE	DEPARTURE FROM NORMAL	AVERAGE DEW POINT	DEGREE DAYS BASE 65°F: HEATING (SEASON BEGINS WITH JUL)	COOLING (SEASON BEGINS WITH JAN)	WEATHER TYPES: 1 FOG 2 HEAVY FOG 3 THUNDERSTORM 4 ICE PELLETS 5 HAIL 6 GLAZE 7 DUSTSTORM 8 SMOKE, HAZE 9 BLOWING SNOW	SNOW ICE PELLETS OR ICE ON GROUND AT 07AM INCHES	PRECIPITATION: WATER EQUIVALENT (INCHES)	SNOW, ICE PELLETS (INCHES)	AVERAGE STATION PRESSURE IN INCHES ELEV. 17 FEET ABOVE M.S.L.	WIND (M.P.H.): RESULTANT DIR.	RESULTANT SPEED	AVERAGE SPEED	FASTEST MILE: SPEED	DIRECTION	SUNSHINE: MINUTES	PERCENT OF TOTAL POSSIBLE	SKY COVER (TENTHS): SUNRISE TO SUNSET	MIDNIGHT TO MIDNIGHT
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	47	32	40	11		25	0	PHYSICAL OPERATION LESS THAN 24 HOURS DAILY	0	0	0					17	35			4	
2	52	28	40	11		25	0		0	.06	0					22	07			10	
3	53*	45	49*	20		16	0		0	.74	0					18	18			9	
4	45	27	36	7		29	0		0	T	T					21	30			8	
5	31	20	26	-3		39	0		0	0	0					26	33			0	
6	27	17	22	-7		43	0		0	.09	.9					21	04			10	
7	35	25	30	1		35	0		3	.33	3.3					28	05			10	
8	32	26	29	-1		36	0		4	T	T					23	32			8	
9	31	18	25	-5		40	0		4	0	0					23	32			5	
10	27	4*	16	-14		49	0		4	0	0					15	36			0	
11	21	10	16*	-14		49	0		3	.51	5.1					28	03			10	
12	33	19	26	-4		39	0		13	.49	4.9					24	02			5	
13	35	7	21	-9		44	0		13	0	0					13	23			0	
14	35	11	23	-7		42	0		12	0	0					7	07			10	
15	47	18	33	3		32	0		11	0	0					17	33			2	
16	39	31	35	4		30	0		10	0	0					13	06			8	
17	41	35	38	7		27	0		7	.16	0					21	09			10	
18	47	37	42	11		23	0		2	0	0					21	35			4	
19	43	32	38	7		27	0		1	0	0					15	01			7	
20	40	24	32	1		33	0		T	0	0					9	18			0	
21	44	23	34	2		31	0		T	0	0					14	23			5	
22	44	30	37	5		28	0		T	0	0					13	15			1	
23	46	36	41	9		24	0		T	.02	0					21	36			10	
24	46	30	38	6		27	0		T	0	0					20	34			8	
25	43	29	36	4		29	0		T	0	0					18	01			9	
26	35	25	30	-3		35	0		T	0	0					22	32			3	
27	44	24	34	1		31	0		0	0	0					18	24			0	
28	50	28	39	6		26	0		0	0	0					13	21			8	
	SUM 1113	SUM 691				TOTAL 914	TOTAL 0	NUMBER OF DAYS		TOTAL 2.40	TOTAL 14.2	FOR THE MONTH:				28	03	TOTAL	% FOR MONTH	SUM 164	SUM
	AVG. 39.8	AVG. 24.7	AVG. 32.3	DEP. 1.7	AVG.	DEP. -41	DEP. 0	PRECIPITATION > .01 INCH 8		DEP. -0.60						DATE: 11+		POSSIBLE		AVG. 5.9	AVG.

NUMBER OF DAYS				SEASON TO DATE			GREATEST IN 24 HOURS AND DATES				GREATEST DEPTH ON GROUND OF SNOW, ICE PELLETS OR ICE AND DATE	
MAXIMUM TEMP		MINIMUM TEMP		TOTAL	TOTAL	SNOW, ICE PELLETS > 1.0 INCH 3	PRECIPITATION		SNOW, ICE PELLETS			
≥ 90°	≤ 32°	≤ 32°	≤ 0°	3744	0	THUNDERSTORMS	1.00	11-12	10.0	11-12	13	13+
0	6	24	0	DEP -130	DEP 0	HEAVY FOG						
						CLEAR 8 PARTLY CLOUDY 6 CLOUDY 14						

* EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE
T TRACE AMOUNT.
\+ ALSO ON EARLIER DATE(S).
HEAVY FOG: VISIBILITY 1/4 MILE OR LESS.
BLANK ENTRIES DENOTE MISSING OR UNREPORTED DATA.

$$ NOTE: JAN. 1983 - COL. 5 DAILY DATA COMPUTED FROM 1941-70 NORMALS. $$

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L. Ray Hoxit
ACTING DIRECTOR
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MAR 1983 94702
BRIDGEPORT, CONNECTICUT
SIKORSKY MEMORIAL AIRPORT

ISSN 0198-1153

LOCAL CLIMATOLOGICAL DATA
Monthly Summary

NATIONAL WEATHER SERVICE OFC

LATITUDE 41° 10' N LONGITUDE 73° 08' W ELEVATION (GROUND) 7 FEET TIME ZONE EASTERN WBAN #94702

DATE	TEMPERATURE °F: MAXIMUM	MINIMUM	AVERAGE	DEPARTURE FROM NORMAL	AVERAGE DEW POINT	DEGREE DAYS BASE 65°F: HEATING (SEASON BEGINS WITH JUL)	COOLING (SEASON BEGINS WITH JAN)	WEATHER TYPES: 1 FOG 2 HEAVY FOG 3 THUNDERSTORM 4 ICE PELLETS 5 HAIL 6 GLAZE 7 DUSTSTORM 8 SMOKE, HAZE 9 BLOWING SNOW	SNOW ICE PELLETS OR ICE ON GROUND AT 07AM INCHES	PRECIPITATION: WATER EQUIVALENT (INCHES)	SNOW, ICE PELLETS (INCHES)	AVERAGE STATION PRESSURE IN INCHES ELEV 17 FEET ABOVE M.S.L	WIND (M.P.H.): RESULTANT DIR	RESULTANT SPEED	AVERAGE SPEED	FASTEST MILE: SPEED	DIRECTION	SUNSHINE: MINUTES	PERCENT OF TOTAL POSSIBLE	SKY COVER (TENTHS): SUNRISE TO SUNSET	MIDNIGHT TO MIDNIGHT	DATE
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	52	32	42	8		23	0	PHYSICAL OPERATION LESS THAN 24 HOURS DAILY	0	.46	0					25	01			10		
2	55	41	48	14		17	0		0	.04	0					28	31			9		
3	55	37	46	12		19	0		0	0	0					25	32			0		
4	40	33	37	3		28	0		0	.02	0					13	07			9		
5	45	34	40	5		25	0		0	.13	0					13	05			6		
6	44	31	38	3		27	0		0	0	0					15	08			8		
7	46	36	41	6		24	0		0	.69	0					21	05			10		
8	39	34	37	1		28	0		0	.76	0					25	05			10		
9	43	37	40	4		25	0		0	.10	0					20	04			10		
10	41	37	39	3		26	0		0	.25	0					18	04			10		
11	44	36	40	3		25	0		0	.48	0					30	01			10		
12	45	35	40	3		25	0		0	.11	0					28	35			9		
13	52	35	44	7		21	0		0	0	0					30	33			5		
14	58	30	44	7		21	0		0	0	0					18	23			4		
15	59*	37	48	10		17	0		0	0	0					24	35			5		
16	55	34	45	7		20	0		0	0	0					18	07			1		
17	44	34	39	1		26	0		0	0	0					22	09			8		
18	48	37	43	4		22	0		0	2.75	0					32	06			10		
19	48	44	46	7		19	0		0	1.46	0					28	08			10		
20	56	40	48	9		17	0		0	0	0					21	29			4		
21	54	39	47	7		18	0		0	.92	0					32	08			10		
22	43	31	37	-3		28	0		0	T	T					24	27			10		
23	38	25	32	-8		33	0		0	0	0					24	27			2		
24	39	26	33	-8		32	0		0	0	0					15	21			4		
25	42	22*	32*	-9		33	0		0	0	0					25	33			8		
26	48	23	36	-5		29	0		0	0	0					21	33			2		
27	46	32	39	-3		26	0		0	.96	0					23	08			10		
28	53	44	49*	7		16	0		0	.08	0					12	28			10		
29	46	30	38	-5		27	0		0	0	0					25	29			3		
30	47	27	37	-6		28	0		0	0	0					20	31			3		
31	41	30	36	-7		29	0		0	0	0					10	04			10		31
	SUM 1466	SUM 1043				TOTAL 754	TOTAL 0	NUMBER OF DAYS		TOTAL 9.21	TOTAL T	FOR THE MONTH:				32	08	TOTAL	% FOR MONTH	SUM 220	SUM	
	AVG. 47.3	AVG 33.6	AVG. 40.5	DEP 2.3	AVG.	DEP -86	DEP 0	PRECIPITATION > .01 INCH 15		DEP 5.28						DATE: 21+		POSSIBLE		AVG. 7.1	AVG.	

NUMBER OF DAYS				SEASON TO DATE			
				TOTAL	TOTAL	SNOW, ICE PELLETS > 1.0 INCH	0
MAXIMUM TEMP		MINIMUM TEMP		4498	0	THUNDERSTORMS	
≥ 90°	≤ 32°	≤ 32°	≤ 0°	DEP	DEP	HEAVY FOG	
0	0	12	0	-216	0	CLEAR 6 PARTLY CLOUDY 6 CLOUDY 19	

GREATEST IN 24 HOURS AND DATES				GREATEST DEPTH ON GROUND OF SNOW, ICE PELLETS OR ICE AND DATE	
PRECIPITATION		SNOW, ICE PELLETS			
4.11	18-19	T	22	0	

* EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.
T TRACE AMOUNT.
\+ ALSO ON EARLIER DATE(S).
HEAVY FOG: VISIBILITY 1/4 MILE OR LESS.
BLANK ENTRIES DENOTE MISSING OR UNREPORTED DATA.

MAXIMUM TEMP. IS NEW RECORD FOR MARCH.

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MAR 1983
BRIDGEPORT, CONNECTICUT

APR 1983 94702
BRIDGEPORT, CONNECTICUT
SIKORSKY MEMORIAL AIRPORT

ISSN 0198 ....

LOCAL CLIMATOLOGICAL DATA

Monthly Summary

NATIONAL WEATHER SERVICE OFC

APR 1983
BRIDGEPORT, CONNECTICUT

LATITUDE 41° 10' N LONGITUDE 73° 08' W ELEVATION (GROUND) 7 FEET TIME ZONE EASTERN WBAN #94702

DATE 1	TEMPERATURE °F: MAXIMUM 2	MINIMUM 3	AVERAGE 4	DEPARTURE FROM NORMAL 5	AVERAGE DEW POINT 6	DEGREE DAYS BASE 65°F: HEATING (SEASON BEGINS WITH JUL) 7A	COOLING (SEASON BEGINS WITH JAN) 7B	WEATHER TYPES (1 FOG, 2 HEAVY FOG, 3 THUNDERSTORM, 4 ICE PELLETS, 5 HAIL, 6 GLAZE, 7 DUSTSTORM, 8 SMOKE, HAZE, 9 BLOWING SNOW) 8	SNOW ICE PELLETS OR ICE ON GROUND AT 07AM INCHES 9	PRECIPITATION: WATER EQUIVALENT (INCHES) 10	SNOW, ICE PELLETS (INCHES) 11	AVERAGE STATION PRESSURE IN INCHES ELEV. 17 FEET ABOVE M.S.L. 12	WIND (M.P.H.): RESULTANT DIR. 13	RESULTANT SPEED 14	AVERAGE SPEED 15	FASTEST MILE: SPEED 16	DIRECTION 17	SUNSHINE: MINUTES 18	PERCENT OF TOTAL POSSIBLE 19	SKY COVER (TENTHS): SUNRISE TO SUNSET 20	MIDNIGHT TO MIDNIGHT 21	DATE 22
1	57	37	47	3		18	0	PHYSICAL OPERATION LESS THAN 24 HOURS DAILY	0	0	0					22	36			5		
2	53	35	44	0		21	0		0	.02	0					15	22			6		
3	44	39	42	-2		23	0		0	1.51	0					33	07			10		
4	57	40	49	4		16	0		0	0	0					15	32			8		
5	58	44	51	6		14	0		0	0	0					21	32			4		
6	53	38	46	1		19	0		0	0	0					17	24			8		
7	52	46	49	3		16	0		0	.11	0					12	17			9		
8	54	47	51	5		14	0		0	.84	0					10	04			10		
9	56	45	51	5		14	0		0	.05	0					20	03			9		
10	48	44	46	-1		19	0		0	3.15	0					36	08			10		
11	58	43	51	4		14	0		0	.01	0					18	31			10		
12	56	41	49	2		16	0		0	0	0					23	33			5		
13	55	42	49	1		16	0		0	0	0					14	18			3		
14	46	38	42	-6		23	0		0	0	0					21	12			9		
15	51	43	47	-2		18	0		0	T	0					25	08			10		
16	46	36	41	-8		24	0		0	2.35	0					31	08			10	10	
17	52	35	44	-5		21	0		0	T	0					24	33			2		
18	45	33	39*	-11		26	0		0	0	0					14	21			10		
19	47	33	40	-10		25	0		T	.75	.5					31	07			10		
20	46	36	4'	-9		24	0		0	T	0					23	27			9		
21	53	41	47	-4		18	0		0	0	0					22	23			8		
22	60	33*	47	-4		18	0		0	0	0					17	30			5		
23	62	38	50	-1		15	0		0	0	0					16	19			6		
24	53	46	50	-1		15	0		0	1.88	0					37	07			10		
25	51	42	47	-5		18	0		0	.05	0					17	06			10		
26	60	42	51	-1		14	0		0	T	0					20	33			8		
27	68	40	54	2		11	0		0	0	0					20	23			5		
28	75*	49	62*	9		3	0		0	0	0					18	18			T		
29	71	50	61	8		4	0		0	0	0					15	19			9		
30	67	54	61	8		4	0		0	0	0					22	18			9		
	SUM 1654	SUM 1230				TOTAL 501	TOTAL 0	NUMBER OF DAYS		TOTAL 10.72	TOTAL 5	FOR THE MONTH:				37	07	TOTAL	% FOR MONTH	SUM 228	SUM	
	AVG 55.1	AVG 41.0	AVG 48.1	DEP -0.5	AVG	DEP 3	DEP 0	PRECIPITATION > .01 INCH 11		DEP. 6.98						DATE: 24		POSSIBLE		AVG. 7.6	AVG	

NUMBER OF DAYS				SEASON TO DATE			GREATEST IN 24 HOURS AND DATES				GREATEST DEPTH ON GROUND OF SNOW, ICE PELLETS OR ICE AND DATE	
MAXIMUM TEMP.		MINIMUM TEMP.		TOTAL	TOTAL	SNOW, ICE PELLETS > 1.0 INCH 0	PRECIPITATION		SNOW, ICE PELLETS			
≥ 90°	≤ 32°	≤ 32°	≤ 0°	4999	0	THUNDERSTORMS	3.16	10-11	.5	19	T	19
0	0	0	0	DEP -213	DEP 0	HEAVY FOG						
						CLEAR 3 PARTLY CLOUDY 7 CLOUDY 20						

* EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.
T TRACE AMOUNT.
\+ ALSO ON EARLIER DATE(S).
HEAVY FOG: VISIBILITY 1/4 MILE OR LESS.
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MAY 1983 94702
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NATIONAL WEATHER SERVICE OFC

MAY 1983
BRIDGEPORT, CONNECTICUT

LATITUDE 41° 10' N LONGITUDE 73° 08' W ELEVATION (GROUND) 7 FEET TIME ZONE EASTERN WBAN #94702

DATE 1	TEMPERATURE °F: MAXIMUM 2	MINIMUM 3	AVERAGE 4	DEPARTURE FROM NORMAL 5	AVERAGE DEW POINT 6	DEGREE DAYS BASE 65°F: HEATING (SEASON BEGINS WITH JUL) 7A	COOLING (SEASON BEGINS WITH JAN) 7B	WEATHER TYPES (1 FOG, 2 HEAVY FOG, 3 THUNDERSTORM, 4 ICE PELLETS, 5 HAIL, 6 GLAZE, 7 DUSTSTORM, 8 SMOKE, HAZE, 9 BLOWING SNOW) 8	SNOW ICE PELLETS OR ICE ON GROUND AT 07AM INCHES 9	PRECIPITATION: WATER EQUIVALENT (INCHES) 10	SNOW, ICE PELLETS (INCHES) 11	AVERAGE STATION PRESSURE IN INCHES ELEV. 17 FEET ABOVE M.S.L. 12	WIND (M.P.H.): RESULTANT DIR. 13	RESULTANT SPEED 14	AVERAGE SPEED 15	FASTEST MILE SPEED 16	FASTEST MILE DIRECTION 17	SUNSHINE: MINUTES 18	PERCENT OF TOTAL POSSIBLE 19	SKY COVER (TENTHS): SUNRISE TO SUNSET 20	MIDNIGHT TO MIDNIGHT 21	DATE 22
1	70	53	62	8		3	0	PHYSICAL OPERATION LESS THAN 24 HOURS DAILY	0	0	0					16	18			10		1
2	62	55	59	5		6	0		0	0	0					24	18			9		2
3	64	54	59	5		6	0		0	T	0					23	19			10		3
4	65	47	56	1		9	0		0	.35	0					18	31			9		4
5	65	40	53	-2		12	0		0	T	0					18	30			4		5
6	64	43	54	-1		11	0		0	0	0					20	22			0		6
7	64	46	55	-1		10	0		0	0	0					18	19			2		7
8	67	47	57	1		8	0		0	.05	0					17	20			8		8
9	56	43	51	-5		14	0		0	.11	0					26	31			7		9
10	59	39	49	-8		16	0		0	0	0					24	23			7		10
11	59	40	50	-7		15	0		0	0	0					17	32			8		11
12	60	41	51	-6		14	0		0	T	0					17	36			4		12
13	65	48	57	-1		8	0		0	0	0					17	34			5		13
14	66	46	57	-1		8	0		0	0	0					16	20			4		14
15	60	52	56	-2		9	0		0	.15	0					12	22			10		15
16	57	41	49	-9		16	0		0	.48	0					22	02			10		16
17	61	37*	49*	-10		16	0		0	0	0					18	30			0		17
18	62	41	52	-7		13	0		0	0	0					18	22			3		18
19	62	45	54	-5		11	0		0	.08	0					15	16			9		19
20	60	55	58	-2		7	0		0	.15	0					18	21			10		20
21	68	55	62	2		3	0		0	.47	0					9	15			10		21
22	71*	53	62	2		3	0		0	.55	0					10	17			8		22
23	69	56	63*	2		2	0		0	.10	0					13	09			8		23
24	63	53	58	-3		7	0		0	.12	0					15	07			9		24
25	70	48	55	-2		6	0		0	0	0					16	20			4		25
26	61	53	57	-5		8	0		0	.55	0					18	05			10		26
27	57	49	53	-9		12	0		0	.65	0					21	08			9		27
28	66	44	55	-7		10	0		0	0	0					21	23			4		28
29	60	56	58	-5		7	0		0	.22	0					13	09			10		29
30	65	57	61	-2		4	0		0	.74	0					13	16			10		30
31	65	52	59	-4		6	0		0	T	0					17	32			9		31
	SUM 1965	SUM 1491				TOTAL 280	TOTAL 0	NUMBER OF DAYS		TOTAL 4.77	TOTAL 0	FOR THE MONTH:				26	31	TOTAL	% FOR PERIOD	SUM 220	SUM	
	AVG. 63.4	AVG. 48.1	AVG 55.8	DEP. -2.7	AVG	DEP 55	DEP -18	PRECIPITATION > .01 INCH 15		DEP. 1.33						DATE: 09		POSSIBLE		AVG. 7.1	AVG	

NUMBER OF DAYS				SEASON TO DATE			GREATEST IN 24 HOURS AND DATES		GREATEST DEPTH ON GROUND OF SNOW, ICE PELLETS OR ICE AND DATE
MAXIMUM TEMP		MINIMUM TEMP		TOTAL	TOTAL	SNOW, ICE PELLETS > 1.0 INCH 0	PRECIPITATION	SNOW, ICE PELLETS	
≥ 90°	≤ 32°	≤ 32°	≤ 0°	5279	0	THUNDERSTORMS	1.20 26-27	0	0
0	0	0	0	DEP -156	DEP -18	HEAVY FOG			
						CLEAR 4 PARTLY CLOUDY 8 CLOUDY 19			

* EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.
T TRACE AMOUNT.
\+ ALSO ON EARLIER DATE(S).
HEAVY FOG: VISIBILITY 1/4 MILE OR LESS
BLANK ENTRIES DENOTE MISSING OR UNREPORTED DATA.

DATA IN COLS 6 AND 12-15 ARE BASED ON 7 OR MORE OBSERVATIONS AT 3-HOUR INTERVALS. RESULTANT WIND IS THE VECTOR SUM OF WIND SPEEDS AND DIRECTIONS DIVIDED BY THE NUMBER OF OBSERVATIONS. ONE OF THREE WIND SPEEDS IS GIVEN UNDER FASTEST MILE: FASTEST MILE - HIGHEST RECORDED SPEED FOR WHICH A MILE OF WIND PASSES STATION (DIRECTION IN COMPASS POINTS). FASTEST OBSERVED ONE MINUTE WIND - HIGHEST ONE MINUTE SPEED (DIRECTION IN TENS OF DEGREES). PEAK GUST - HIGHEST INSTANTANEOUS WIND SPEED (A / APPEARS IN THE DIRECTION COLUMN). ERRORS WILL BE CORRECTED AND CHANGES IN SUMMARY DATA WILL BE ANNOTATED IN THE ANNUAL PUBLICATION.

I CERTIFY THAT THIS IS AN OFFICIAL PUBLICATION OF THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, AND IS COMPILED FROM RECORDS ON FILE AT THE NATIONAL CLIMATIC DATA CENTER, ASHEVILLE, NORTH CAROLINA, 28801

L. Ray Hoxit
ACTING DIRECTOR
NATIONAL CLIMATIC DATA CENTER

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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL ENVIRONMENTAL SATELLITE, DATA AND INFORMATION SERVICE
NATIONAL CLIMATIC DATA CENTER ASHEVILLE NORTH CAROLINA

JUN 1983 94702
BRIDGEPORT, CONNECTICUT
SIKORSKY MEMORIAL AIRPORT

ISSN 0198-1153

LOCAL CLIMATOLOGICAL DATA

Monthly Summary

NATIONAL WEATHER SERVICE OFC

LATITUDE 41° 10' N LONGITUDE 73° 08' W ELEVATION (GROUND) 7 FEET TIME ZONE EASTERN WBAN #94702

DATE	TEMPERATURE °F					DEGREE DAYS BASE 65°F		WEATHER TYPES 1 FOG 2 HEAVY FOG 3 THUNDERSTORM 4 ICE PELLETS 5 HAIL 6 GLAZE 7 DUSTSTORM 8 SMOKE, HAZE 9 BLOWING SNOW	SNOW ICE PELLETS OR ICE ON GROUND AT 07AM INCHES	PRECIPITATION		AVERAGE STATION PRESSURE IN INCHES ELEV. 17 FEET ABOVE M.S.L.	WIND (M.P.H.)					SUNSHINE		SKY COVER (TENTHS)		DATE
	MAXIMUM	MINIMUM	AVERAGE	DEPARTURE FROM NORMAL	AVERAGE DEW POINT	HEATING (SEASON BEGINS WITH JUL)	COOLING (SEASON BEGINS WITH JAN)			WATER EQUIVALENT (INCHES)	SNOW, ICE PELLETS (INCHES)		RESULTANT DIR.	RESULTANT SPEED	AVERAGE SPEED	FASTEST MILE SPEED	FASTEST MILE DIRECTION	MINUTES	PERCENT OF TOTAL POSSIBLE	SUNRISE TO SUNSET	MIDNIGHT TO MIDNIGHT	
1	2	3	4	5	6	7A	7B	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	73	49	61	-3		4	0	PHYSICAL OPERATION LESS THAN 24 HOURS DAILY	0	.01	0					16	22			6		1
2	74	50	62	-2		3	0		0	T	0					20	33			3		2
3	74	50	62	-2		3	0		0	.05	0					16	20			6		3
4	69	57	63	-2		2	0		0	1.21	0					23	20			10		4
5	77	55	66	1		0	1		0	0	0					17	20			1		5
6	77	59	68	3		0	3		0	T	0					18	18			5		6
7	78	61	70	4		0	5		0	0	0					16	23			9		7
8	74	55	65	-1		0	0		0	0	0					17	33			6		8
9	65	49	57	-9		8	0		0	0	0					15	10			3		9
10	66	47*	57*	-9		8	0		0	0	0					14	09			5		10
11	81	55	68	1		0	3		0	0	0					18	20			1		11
12	89	56	73	6		0	8		0	0	0					15	22			3		12
13	86	64	75	8		0	10		0	0	0					14	20			1		13
14	78	65	72	4		0	7		0	0	0					15	11			5		14
15	90	62	76	8		0	11		0	.95	0					16	20			4		15
16	75	62	69	1		0	4		0	0	0					15	10			6		16
17	70	60	65	-3		0	0		0	0	0					12	09			6		17
18	76	60	68	-1		0	3		0	0	0					12	21			9		18
19	84	59	72	3		0	7		0	0	0					14	25			10		19
20	77	67	72	3		0	7		0	T	0					13	03			10		20
21	79	63	71	2		0	6		0	0	0					10	02			9		21
22	82	57	70	0		0	5		0	0	0					12	20			0		22
23	87	61	74	4		0	9		0	0	0					17	23			5		23
24	90*	64	77*	7		0	12		0	0	0					21	34			3		24
25	76	57	67	-4		0	2		0	0	0					28	34			1		25
26	74	55	65	-6		0	0		0	0	0					16	20			6		26
27	85	62	74	3		0	9		0	T	0					21	05			7		27
28	71	57	64	-7		1	0		0	1.50	0					25	09			10		28
29	74	55	65	-6		0	0		0	0	0					15	03			2		29
30	75	59	69	-3		0	4		0	0	0					17	20			1		30
	SUM	SUM				TOTAL	TOTAL	NUMBER OF DAYS		TOTAL	TOTAL	FOR THE MONTH:						TOTAL	% FOR MONTH	SUM	SUM	
	2330	1732				29	116			3.72	0					28	34			155		
	AVG.	AVG.	AVG.	DEP.	AVG.	DEP.	DEP.	PRECIPITATION		DEP.						DATE: 25		POSSIBLE		AVG.	AVG.	
	77.7	57.7	67.7	-0.2		5	9	≥ .01 INCH	5	0.82										5.2		

NUMBER OF DAYS				SEASON TO DATE				GREATEST IN 24 HOURS AND DATES				GREATEST DEPTH ON GROUND OF SNOW, ICE PELLETS OR ICE AND DATE	
				TOTAL	TOTAL	SNOW, ICE PELLETS ≥ 1.0 INCH	0						
MAXIMUM TEMP.		MINIMUM TEMP.		5308	116	THUNDERSTORMS		PRECIPITATION		SNOW, ICE PELLETS			
≥ 90°	≤ 32°	≤ 32°	≤ 0°	DEP.	DEP.	HEAVY FOG		1.50	28	0		0	
2	0	0	0	-153	-9	CLEAR 11	PARTLY CLOUDY 11	CLOUDY 6					

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